Compressed Air Magazine

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MAY, 1926

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WHERE THE WIACHUAN RIVER EMPTIES INTO THE EAST SIDE OF HUDSON BAY IT MAKES A PICTURESQUE AND THUNDEROUS DROP OF 315 FEET

Utah Is Now Making Iron
R. G. Skerrett

Work Begun on New Mersey Tunnel
A. L. Murphy

Our Worry Turned To Satisfaction
G. F. Pettinos

Waterbury Driving a Long Rock Tunnel
S. G. Roberts

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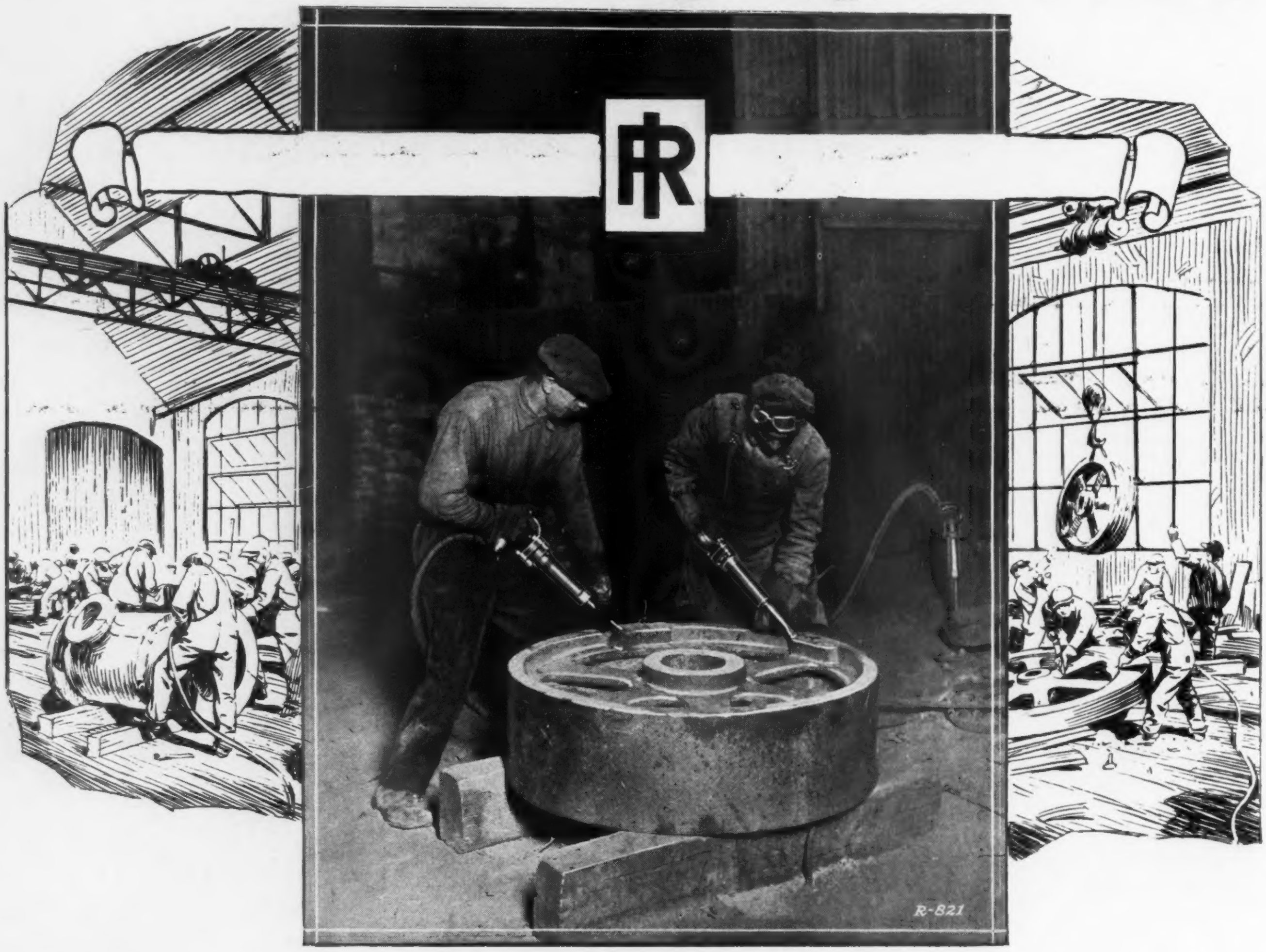
High-Speed Hammers for High-Speed Work



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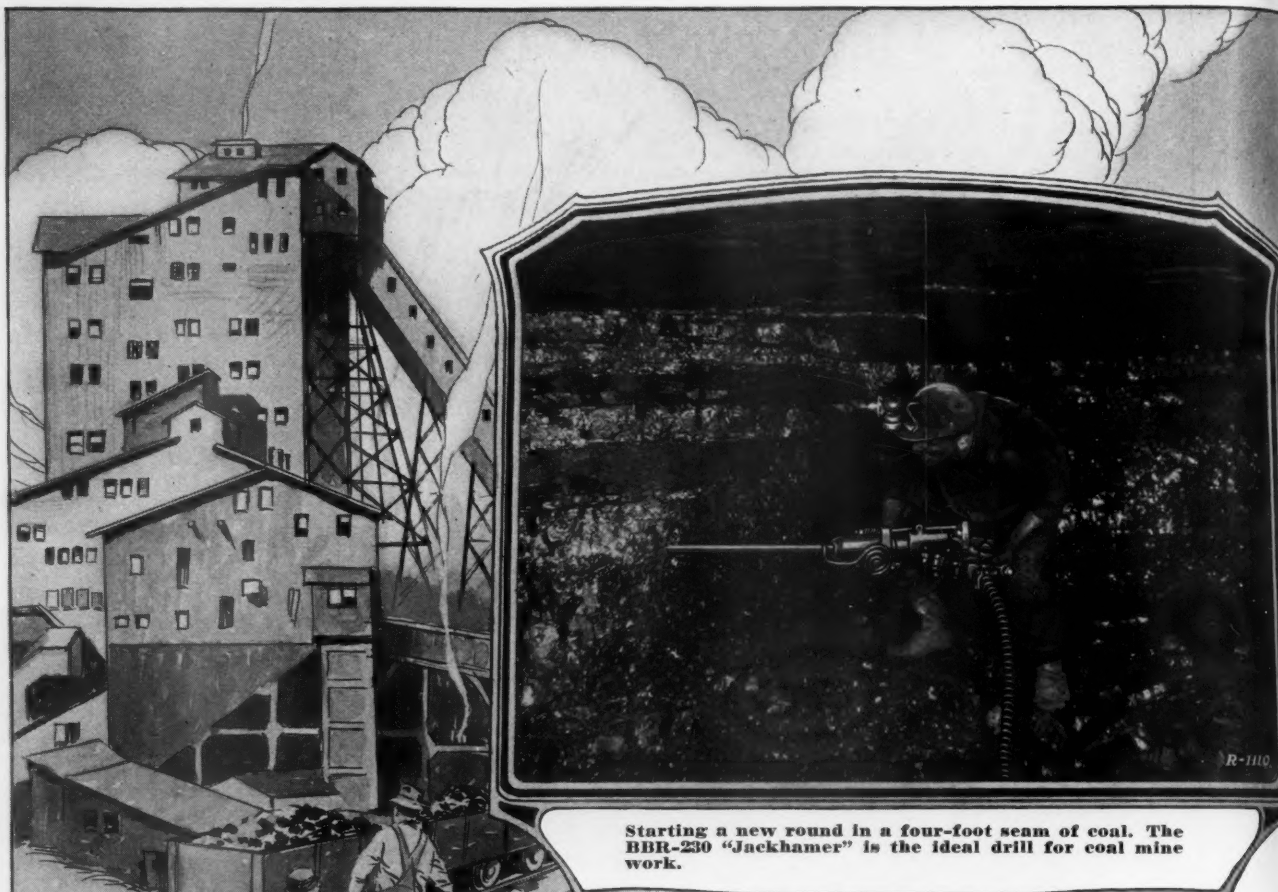

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VOL. XXXI, NO. V

MAY, 1926

Waterbury Driving A Long Rock Tunnel

This Bustling Connecticut City is Building a 38,200-Foot Tunnel to Obtain an Ample Supply of Water

By S. G. ROBERTS

WATERBURY is situated in the beautiful and bustling Naugatuck Valley of Connecticut; and for many years this thriving city has been noted for the number and the varied nature of its industries. The municipality has grown from a population of 13,106 in 1870 to a present total of more than 100,000 inhabitants.

The question of an ample supply of water to meet increasing demands has for a considerable period engaged the attention of the civic authorities; and steps are now being taken to insure an adequate supply of water both in the near future as well as when Waterbury becomes a much larger place than it is now.

To obtain this water from an untainted source, the city is driving a tunnel, seven and a quarter miles long, that will tap a watershed having an area of 37 square miles. The undertaking has many interesting engineering aspects.

AN adequate and a sanitary supply of water is becoming a pressing problem with many American communities. This is especially true wherever the population has grown rapidly of late. Not only is more water used per capita now than previously but the health authorities are far more particular about the purity of that water than they formerly were. As a consequence, it frequently becomes necessary to go farther and farther afield in order to tap sources which meet the twofold requirements of purity and quantity.

Waterbury, Conn., is a typical example of this reaching out for more water; and, thanks to the initiative and the foresight of its responsible experts, the city is making such provision for the future that she can be assured an abundance of good water for decades, even though her population may be greatly augmented.

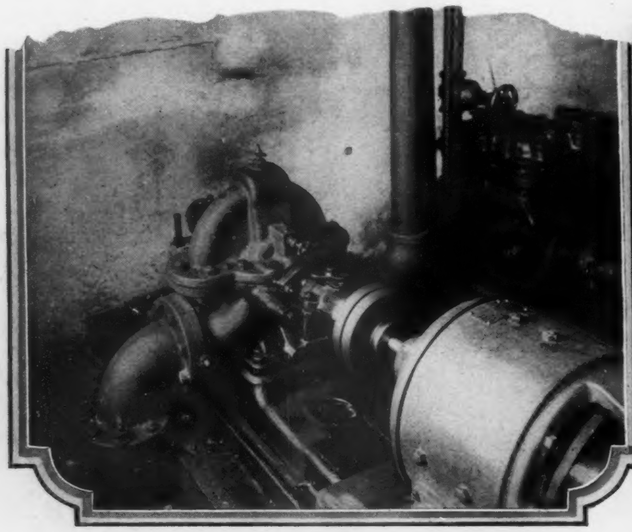
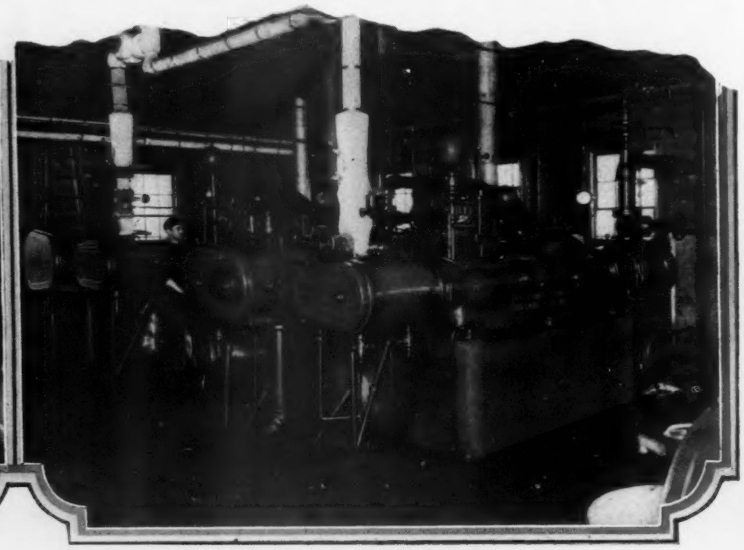
Until 1893, the water works of the town consisted of some small reservoirs a few miles away—built in 1869 and 1883. But two of these are now in service, and they have a combined capacity of 220,000,000 gallons and are utilized to supply only some of the higher parts of the community. In 1893, 1900, and 1912, other reservoirs were constructed ten miles northwest of Waterbury; and these now provide most of the water used. The two newer reservoirs in question are: a distributing reservoir, having a capacity of 730,000,000 gallons, and a storage reservoir capable of holding 2,000,000,000 gallons. The intention is to create a third reservoir in the same valley; and this basin, when full, will contain 1,440,000,000 gallons of water.

The original waterworks, built in 1869, drew from a watershed having an area of about one square mile; and the two large reservoirs, just described, obtain their water from a region having a run-off area of 18 square miles located in the valley of the West Branch of the Naugatuck River. The new watershed in the Shepaug River Valley has a drainage area of 37 square miles and will, therefore, be substantially twice as large as that of the combined run-off now available.

The Shepaug project has bristled with difficulties from the very start. As far back as 1898, plans were outlined that called for the taking over of additional watershed territory to the north of the valley of the West Branch of the Naugatuck, but the legislature stepped in and passed an act which prohibited the city from diverting water from the contemplated region. It was this situation that finally forced the municipality to seek relief farther to the westward and in the upper waters of the Shepaug River. Even there obstacles had to be overcome, because, in Connecticut, it is hard to get control of a watershed from which water is to be diverted to another watershed and not temporarily halted in its ordinary course. This opposition is due to the fact that owners of riparian rights lying below a point of diversion must necessarily suffer from any diminution of the flow past their properties. The Shepaug Tunnel project involves just such a diversion and a reduction of the normal volume of flow southward of the tunnel intake. However, the legal difficulties were eventually disposed of to the satisfaction of all concerned.

The Shepaug watershed lies to the north and to the west of the present utilized watershed, from which it is separated by two lines of hills and the intermediate valley of the Bantam River. Having been fortunate enough to find a suitable source of water, the next phase of the problem was to determine how best to insure the delivery of that water to the city. Many of the details that follow, as well as much of the information that has preceded, were graciously furnished by Mr. R. A. Cairns, who has for years held the responsible office of City Engineer in Waterbury. Indeed, the acquisition of the new watershed was largely due to Mr. Cairns' foresight and to his realization that prompt and effective efforts were required to insure the municipality sufficient water in the years to come.

In Connecticut, most of the valleys have a north and south trend, with dividing walls

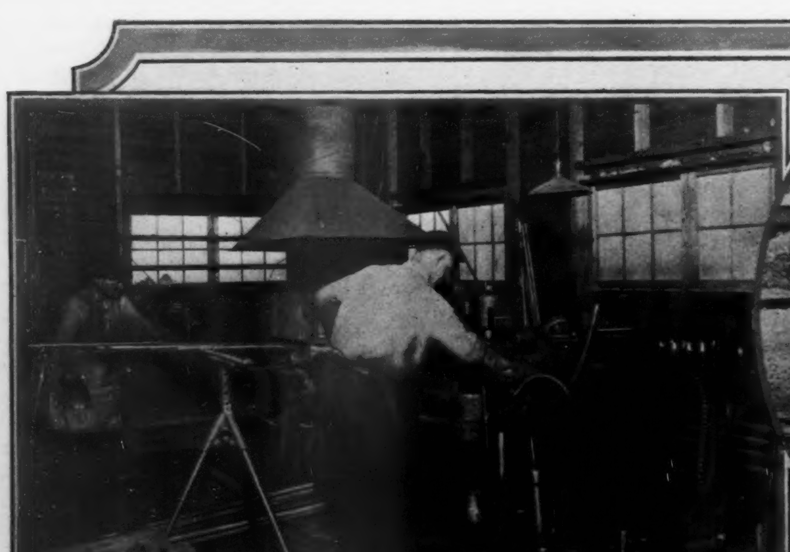
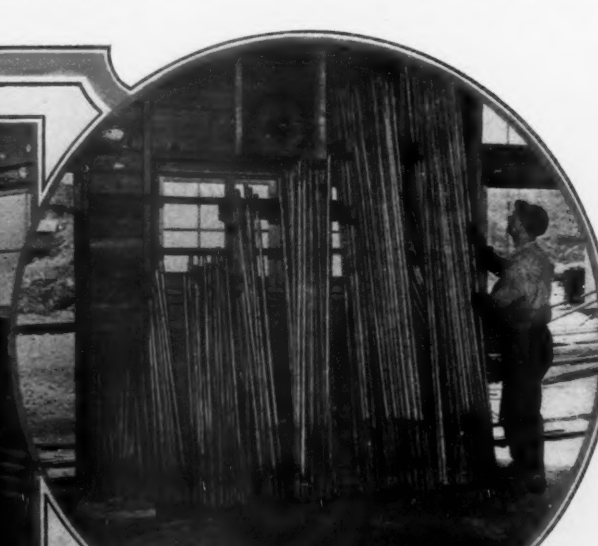
**Left—Cameron pump that furnishes feed water to the boilers in the power plant at the Bantam River Camp.
Right—the compressed air, used at the headings dependent upon the Bantam River power station, is furnished by two "XPV" compressors.**

formed by hills several hundred feet high; and it was self-evident that water could be transferred from the Shepaug Valley to the valley of the West Branch of the Naugatuck in three ways. First by pumping the water up and over the intervening ridges; second, by carrying the water in a gravity pipe line, 21 miles in length, directly to the city; or, third, by a tunnel piercing and underrunning the separating ridges lying between the Shepaug River and the West Branch of the Naugatuck. Investigation and study emphasized the superiority of the tunnel plan. Some of the advantages peculiar to the tunnel are: ample capacity for future water demands; freedom from structural deterioration; and the prospect of little if any expense in connection with maintenance and repairs—combined with comparative security against malicious injury or interference.

The Shepaug project calls for the ultimate building of a dam, across the Shepaug Valley, that will have a sufficient height to insure a depth of 100 feet of water within the impounded area—that is to say, this reservoir will have a surface area of 273 acres and be capable of holding 2,250,000,000 gallons. Inasmuch as it will be years before Waterbury will need a supply of this additional magnitude, the intention is first to construct only the lower courses of the dam—in other words, to make the dam just high enough to serve as a diversion dam that will lead a part of the river's flow into the tunnel intake. No work has yet been done on the dam, and none will be done until the tunnel is substantially completed.

The driving of the tunnel was begun on the east bank of the Shepaug during the summer of 1922. As a preliminary, a power plant and a camp were established at that west portal—the power equipment consisting of a suitable boiler plant, a steam-driven electric generator, and an I-R compressor of sufficient capacity to provide operating air for the drills used in attacking the rock. At the start, it was necessary to tunnel through more than 200 feet of glacial drift, which necessitated heavy timbering and lagging. When about 213 feet in from the portal, the surface of the rock was encountered; and during the transition from earth to rock the excavating was slow and dangerous because of underground water and owing to the fact that it was permissible to use only light charges of dynamite. When the full rock face was eventually developed at a point 269 feet in from the portal, timbering was no longer required, and progress went forward in an orderly manner.

The minimum height of the rock tunnel is 7.5 feet and the minimum width is 7.0 feet. The

**Left—Blacksmith shop, at the Bantam River Camp, equipped with a "Leyner" sharpener and an I-R oil furnace.
Right—Various lengths of steels used in the rock drills employed in driving the Shepaug Tunnel.**

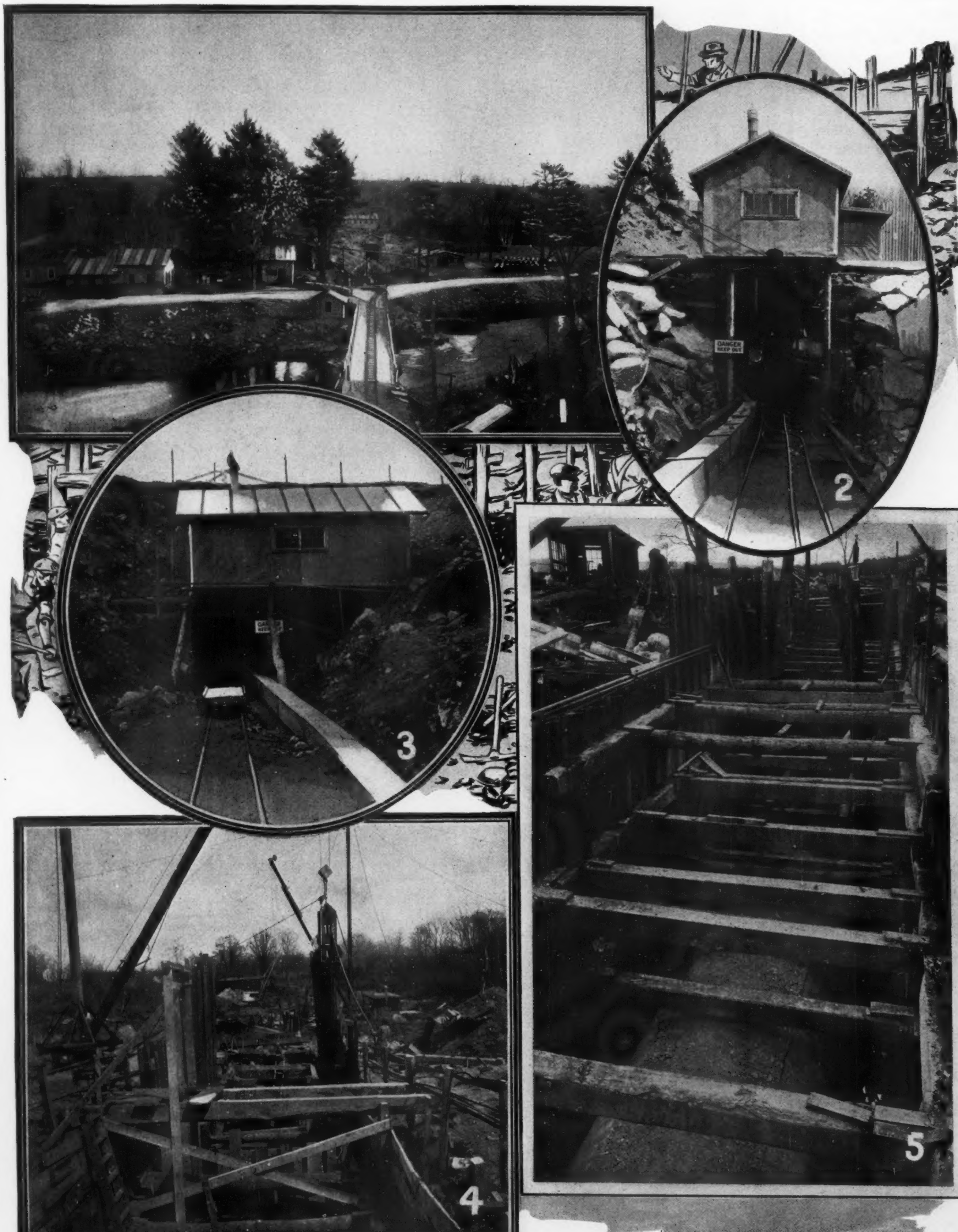
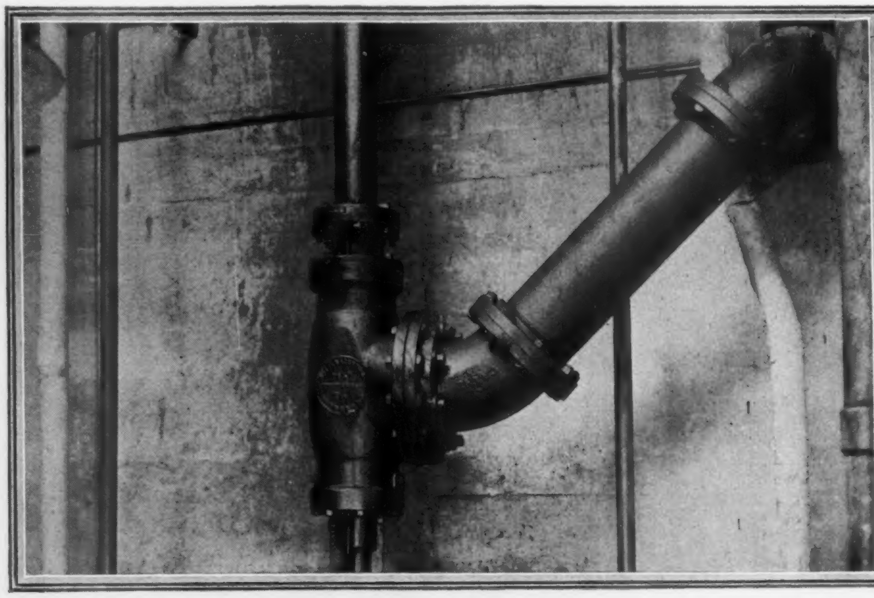


Fig. 1—Looking eastward across the Bantam River toward the camp and the power house.
Fig. 2—Tunnel portal at east side of Bantam River.
Fig. 3—Tunnel portal at west side of Bantam River.
Fig. 4—Driving steel sheet piling with air-operated hammer in Ravenscroft Swamp.
Fig. 5—Concrete tunnel section in trench dug in Ravenscroft Swrmp.



Condenser which handles exhaust steam in the Bantam River power plant for the Shepaug Tunnel work.

roof is semi-circular with a 3.5-foot radius. The drill rounds varied as the rock, which is a gneiss, changed in relative hardness, but the general arrangement of the drill holes remained the same—each hole being about 7 feet deep. The central holes were shot first, those around the rim followed, while the lifters were the last to be fired. The center charge was the heaviest. An advance of about 6¼ linear feet was made at each blast.

Operations at the west or Shepaug portal continued until the heading had been advanced eastward a distance of 6,652.3 feet—the drilling being done at first with "Jackhamers" mounted on vertical columns. The rock at the west portal was somewhat faulted; and at points the rock was reinforced to check any inward movement. The west portal plant was subsequently transferred to the easternmost end of the tunnel line, that is, the Heminway portal, where the tunnel will discharge into the valley of the West Branch of the Naugatuck River.

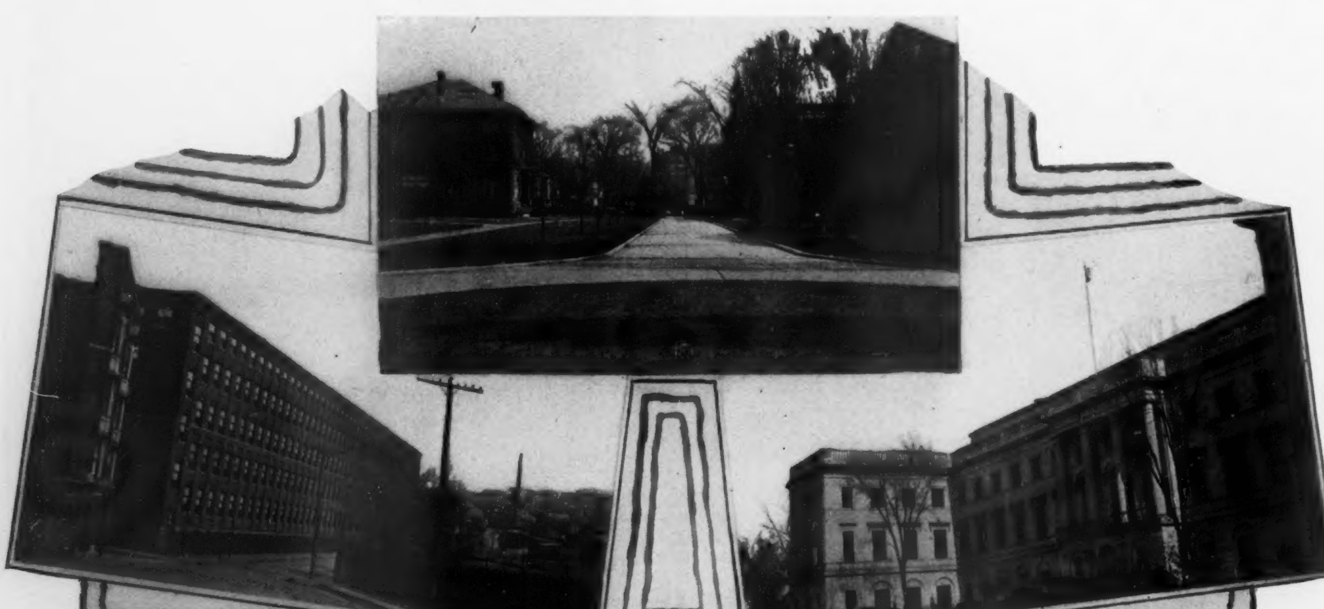
The smoke and the gases produced by blasting at the west portal were moved rearward from the immediate neighborhood of the heading by compressed air discharged a short distance back from the heading, and then the foul air was picked up by the intake of a suction fan and carried out of the tunnel. At first, the muck was moved to the dump in steel cars, each of 18-cubic-foot capacity, which were shoved by hand to the tunnel mouth. Later on, this work was done by two 3-ton storage-battery locomotives.

Operations at the west portal continued from July of 1922 until June of 1924—the work being done night and day by a force carried on the city payroll. With the cessation of activities at the west portal, operations were started at three other points of attack along the line of the tunnel—namely, westward from the outfall or Heminway portal, eastward from the Bantam River, and westward from the same stream. Before touching upon any of the details of the latter phases of the undertaking, it would make the work at these headings more understandable if we described the tunnel as a whole.

From end to end, the tunnel system spans a total distance of 38,200 feet; and all but 1,267 feet of this acqueduct will pierce rock. The exceptions are where the tunnel crosses Ravenscroft Swamp and also where a 697-foot siphon is interposed between the portals on the east and the west side of the Bantam River Valley—in these two cases it has been necessary to resort to trenching. Part of the rock work will involve driving the tunnel 150 feet below the surface of Bantam Lake; and there the tunnel will underrun that body of water for a distance of 4,000 feet. Operations on this section are now in hand.

Where the siphon passes below the bed of Bantam River, the line of the tunnel grade crosses that stream about 10 feet above the channel. It was at first proposed to carry the tunnel over the river on an aqueduct with arched supports. After further study, it was decided to build a terminal chamber on each side of the river and to connect these chambers by means of three 36-inch mains laid in an open trench dug in the river bed—the cofferdam for this purpose being formed by flanking walls of steel sheet piling.

In Ravenscroft Swamp, the open trench dug there for 570 feet had a depth of 30 feet—the sides being supported by steel sheet piling. The bed of the swamp is largely composed of a peat-like material which is extremely unstable—in fact, flows like water, and the stuff proved very troublesome. In the open trench, the tunnel is a concrete structure, of horseshoe section, having a finished internal height of 7 feet and a width of 6½ feet. This part of



Snapshots of some of Waterbury's educational and industrial buildings.

the tunnel rests on a double line of piles—driven to bedrock or refusal—placed longitudinally at 3-foot intervals. The invert and 8 inches of each side wall were cast first and integrally—a unit section 15 feet long being cast at a time. Afterwards, the remainder of the side walls and the arch were cast in 30-foot sections—using metal collapsible forms.

To take care of the power requirements at the two portals on the Bantam River and vides circulating water for the condenser; one Schutte-Koerting condenser; and two steam-driven "XPV" plate-valve compressors, respectively, of 14- and 16-inch stroke. Operating air for the two Bantam River portals and for the heading working westward from Ravenscroft Swamp is supplied by the compressors just mentioned.

In connection with the camp on the Bantam River, the city engineer saw to it that a special paratory to going underground. These facilities have, undoubtedly, contributed greatly to the comfort and the physical well-being of the men.

The size of the tunnel was chosen because the cross section was one that could be most economically excavated. Therefore, while the tunnel will be called upon to deliver at the outfall end a maximum of 40,000,000 gallons daily, still the tunnel will be large enough to convey

Some points of interest at the Bantam River Camp.

where the tunnel again enters rock west of Ravenscroft Swamp, a power plant and a camp for the workers were established on the east bank of the Bantam River. This plant is steam driven; and steam power was decided upon because it was believed more likely to prove dependable than purchased electric current. The Bantam River plant is equipped with three fire-tube boilers; one Cameron pump that pro- drying room was provided in the change house for the tunnel workers. This room is steam heated and is equipped with lockers. This arrangement, in combination with washing facilities that include a plenty of hot water, has made it possible for the men coming off shift to bathe and to get right into warm and dry garments. Similarly, the working clothes are dry and warm when the men put them on pre- a much greater volume of water. For the first 2½ miles eastward from the Shepaug portal, the tunnel gradient is .0008 foot; the succeeding 1¼ miles will have a gradient of .005 foot; while the remainder of the tunnel will have a gradient of .001 foot. In other words there will be a natural flow of the water from the intake to the discharge portal.

The rock encountered at the various sections

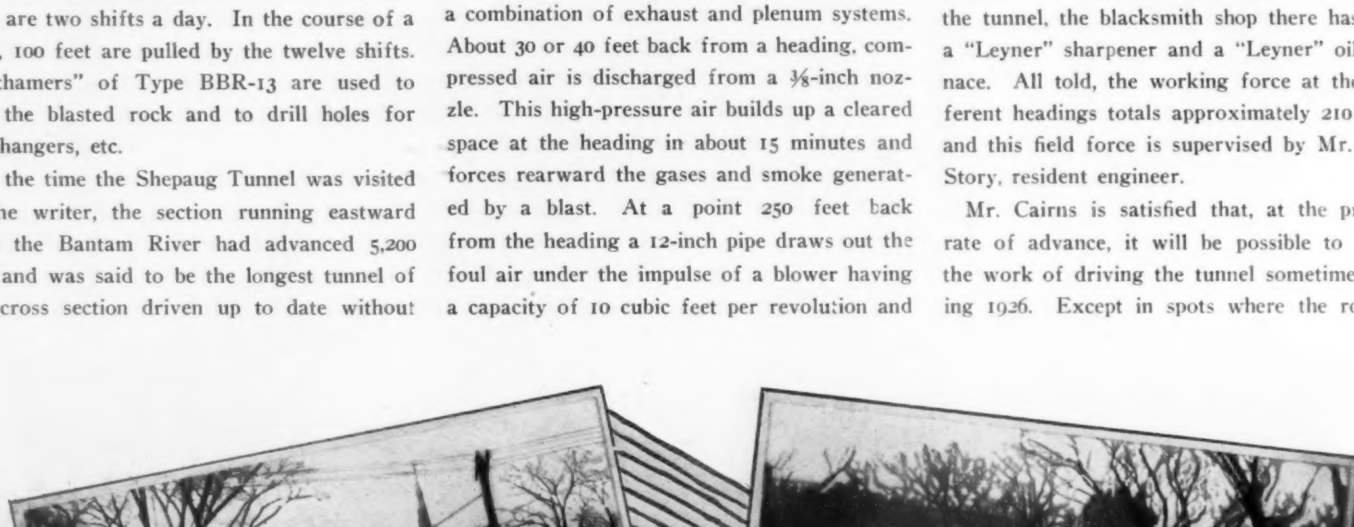
of the tunnel has been and is organically similar to that first penetrated in driving the heading eastward from the west or Shepaug portal —that is to say, the rock is a granite formation which is at times hard and at other times relatively soft. The method employed at the several headings is substantially identical with the procedure that was originally practiced at the west portal. Two No. 248 drifters do the drilling at each heading. The drills are mounted on vertical columns, and 24 holes constitute a round. There is a V-shaped central cut. The holes are driven to a depth of 10 feet; one round is made at each shift; and there are two shifts a day. In the course of a week, 100 feet are pulled by the twelve shifts. "Jackhamers" of Type BBR-13 are used to trim the blasted rock and to drill holes for pipe hangers, etc.

Dam and spillway of the Morris Reservoir from which Waterbury draws much of its water.

At the time the Shepaug Tunnel was visited by the writer, the section running eastward from the Bantam River had advanced 5,200 feet, and was said to be the longest tunnel of that cross section driven up to date without intervening shafts or adits. The means resorted to to insure satisfactory ventilation are a combination of exhaust and plenum systems. About 30 or 40 feet back from a heading, compressed air is discharged from a ⅜-inch nozzle. This high-pressure air builds up a cleared space at the heading in about 15 minutes and forces rearward the gases and smoke generated by a blast. At a point 250 feet back from the heading a 12-inch pipe draws out the foul air under the impulse of a blower having a capacity of 10 cubic feet per revolution and making 250 revolutions a minute. This blower, located just outside the portal, is belt driven from a 35-kilowatt motor. The tunnel, when 5,200 feet long, was cleared from end to end in an hour. Water seeping into the tunnel sections has generally been kept under control by electrically operated pumps

The blacksmith shop at the Bantam River camp is equipped with a "Leyner" sharpener and a "Leyner" oil furnace. That shop takes care of the steels for work at both Bantam River portals as well as for the heading driven westward from the west side of Ravenscroft Swamp. At the east or Heminway portal of the tunnel, the blacksmith shop there has also a "Leyner" sharpener and a "Leyner" oil furnace. All told, the working force at the different headings totals approximately 210 men, and this field force is supervised by Mr. I. F. Story, resident engineer.

Mr. Cairns is satisfied that, at the present rate of advance, it will be possible to finish the work of driving the tunnel sometime during 1926. Except in spots where the rock is



Glimpses of Waterbury's civic center and the front of her handsome Court House.

soft, the tunnel will not be lined. In the soft spots the rock will be steadied by a concrete lining, in the placing of which compressed air will probably be used. The water-supply system, when completed, will be large enough to take care of the needs of Waterbury when the population of the city reaches 200,000 persons and local industry has developed proportionately. Mr. Cairns is convinced that the procedure employed in driving the Shepaug Tunnel will result in a substantial saving to the municipality when compared with what the undertaking would cost if done by contracting.

The London "Post Office Tube Railway," now under construction, has a diameter of 9 feet, a length of 6½ miles, and extends from Paddington in the east to Whitechapel in the west. Upon two sets of rails will travel automatically controlled electric cars, each carrying 1,000 pounds of mail, and the trains are to be run with a frequency of 30 per hour in each direction. There are a number of substations along the line giving access to important dispatching and receiving centers. Connecting branches reaching northward and southward are being considered. Ninety cars are being built for the service, which is expected to be in full working order by July of this year.

Steamers of the American Oriental Mail Line are carrying a considerable quantity of ice cream on each trip from Seattle, Wash., to Shanghai, China. Those who are handling the business are predicting an immense future for the trade in that section of the Far East; and they go so far as to say that it will not be long before China will have her own ice-cream plants as well as cold-storage facilities, of which that country is sadly in need.

It is reported that a balloonist has been able to hear a man's shout at an elevation of 1,600 feet; the croaking of frogs in a marsh at 3,000 feet; the roll of drums at 4,500 feet; the pealing of church bells at 5,000 feet; the rumble of a train at 8,200 feet; and the shriek of a locomotive when soaring at an altitude of 10,000 feet.

CRUDE OIL MADE TO YIELD MORE GASOLINE

REGARDING the growing demand for gasoline, it is interesting to note that the amount of gasoline obtained from a barrel of crude oil has been increasing steadily since 1918. Refiners of oil, in 1925, got 21 per cent. more gasoline by running only 16.7 per cent. more crude—that is, had the yield of gasoline per barrel of crude been the same as that in

A, west portal at Shepaug River; B, Ravenscroft Swamp; C, Bantam River Valley; D, Bantam Lake; and E, east or Heminway portal.

1918, then 950,000,000 barrels of crude would have been required in 1925 instead of 741,000,000 barrels.

This increase in gasoline production is the result of cracking, and this method of refining is being continually expanded. Its ultimate effect on the petroleum situation is not yet fully appreciated. The yield of natural gasoline, gasoline derived from natural gas, was also increased during 1925.

Another factor that has a vital bearing on this matter of providing increasing supplies of gasoline without proportionately drawing on our oil reserves, is the automobile engine. It is now recognized that improvements in design will make it entirely feasible thus to reduce the gasoline requirements probably by one-half. According to a statement by The National City Bank, of New York City, industrial and engineering organizations in the petroleum and the automotive industries are coöperating to this end.

RESTORING RESPIRATION

CASES of temporarily suspended respiration, as we only too unhappily know, are not of infrequent occurrence, especially among firemen, miners, and attendants at automobile service stations who are often subjected to noxious gases.

The pulmotor and kindred equipment have long been recognized as ready means of relief; and we have well-nigh daily reminders of the splendid service rendered by these life-saving outfits. It must be borne in mind, however, that time is very precious and that the slightest delay in getting the somewhat bulky outfits to the scene of an accident may spell disaster. Besides, it is necessary to provide as many pulmotors as there are patients.

Recently, attention has been called to the successful administration of a drug in cases of carbon-monoxide poisoning or in cases of suspended respiration brought about by a wide variety of other causes. This drug, known as Alpha-Lobelin-Ingelheim, possesses the peculiar property of almost instantly stimulating respiration. One physician, says a writer in *The New York Times*, with a hypodermic syringe and a number of phails of the drug, can render aid to several subjects at once. It is said that in certain countries abroad, doctors connected with mines, railways, and large industrial concerns are required to carry Alpha-Lobelin-Ingelheim in their emergency outfits.

HOW NEW YORK CITY TURNS NIGHT INTO DAY

NOWHERE in the world is night turned into day so completely as along the "Great White Way" of New York City. This transformation is caused by numerous electric signs which have a combined output of 25,000,000 candle power, according to Arthur Williams of the New York Edison Company.

Of the 17,000 electric signs on Manhattan Island below 135th street, more than 2,800 advertise restaurants; 1,300 are hung before barber shops; 1,100 encourage the consumption of different tobaccos; 867 tell you what to wear; and 763 advertise automobiles and their accessories. Contrary to popular opinion, theaters are seventh on the list, with 706 electric signs. Last year about 5,000 illuminated signs were added to Gotham's skyline.

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Air-driven clay diggers make light work of ice in the streets of Albany.

CLAY DIGGERS CLEAR AWAY ICE

A GREAT problem in many of our northern cities each winter is the removal of the caked snow and ice from the thoroughfares. In business districts, especially where it is essential that traffic be kept open, civic authorities have had no other recourse in the past but to employ an army of transient laborers and to equip them with picks and shovels. Accomplishing the work in this manner is both slow and costly.

During the past winter, the Department of Public Works, Albany, N. Y., has been able to solve this troublesome problem by equipping a few workmen—an army not being essential—with pneumatic clay diggers provided with cutting spades. An I-R portable compressor furnished the necessary operating air for these tools. This equipment was first used on State Street. Four men, so outfitted, found no difficulty in breaking up the compacted mass that, in some places, was anywhere from 8 to 15 inches in thickness. Where the ice was only a few inches thick, it was possible with the portable and the clay diggers to clear an entire block in a few hours. The ease and the speed with which the work was accomplished stirred the enthusiasm of the crowd that had gathered to view this novel method of ice removal.

"We are satisfied with the air-operated clay diggers," said Lester W. Herzog, commissioner of public works, as he watched the initial performance of these tools. "It is the first apparatus we have been able to purchase which removes ice cleanly and quickly from the streets. The spades are too light to do any damage to the paving, but they rip through the ice without any difficulty."

ROADBUILDING MACHINERY MUST BE STURDY

IN THESE days, when high-powered motor cars can run with almost equal facility up steep grades as on level stretches, much roadbuilding is being done in mountainous sections of the country in order to open up new scenic wonders to the touring public. To get to the point of operations, contractors are often obliged to transport their equipment for miles, in other words, the equipment is not infrequently subjected to considerable jolting and jarring before actual work can be started. This means, of course, that all the machinery in a roadbuilder's outfit must be of sturdy construction not only to live up to the work expected of it but to stand up under the rough treatment that it not infrequently receives in transit.

Out in California, for example, where a highway is being built over Yuba Pass, a portable compressor and associate equipment had to be towed along a road leading from Blairsden to Sierra City. This roadway is extremely narrow and steep, and involves climbing to a pass having an altitude of 7,000 feet. As shown by the accompanying photograph, a caterpillar tractor was employed to tow the compressor, which was none the worse for the rough journey that it had to make.

Tractor pulls portable compressor up steep mountain to help build road through Yuba Pass.

The Yuba Pass Road starts at Sierra City and follows the Yuba River, along the base of the Sierra Buttes, for a distance of 3½ miles. It will have an average gradient of 5 per cent. It is estimated that 20 per cent. of the 55,000 cubic yards of material to be excavated consists of rock. The road will make accessible to the public what is said to be one of the most beautiful sections of the State of California. Tieslau Brothers are the contractors on the job.

"Worry Turned to Satisfaction"

This is What Happened When a Tugboat was Equipped With an Oil Engine Instead of a Steam Prime Mover

By GEORGE F. PETTINOS

THE tugboat "Sonittep" is a vessel 95 feet long that has a beam of 20 feet and a 10-foot depth of hold. For years, her owner relied upon steam-driven tugs for towing service; and he was prejudiced in favor of steam as a prime mover until conditions made it imperative for him to effect economies without any sacrifice in operating efficiency.

The accompanying article was prepared by Mr. Pettinos in response to an impulse to tell other tugboat operators how much could be gained by adopting oil-engine drive; and we believe his experience will prove of interest and of value to many of our readers.

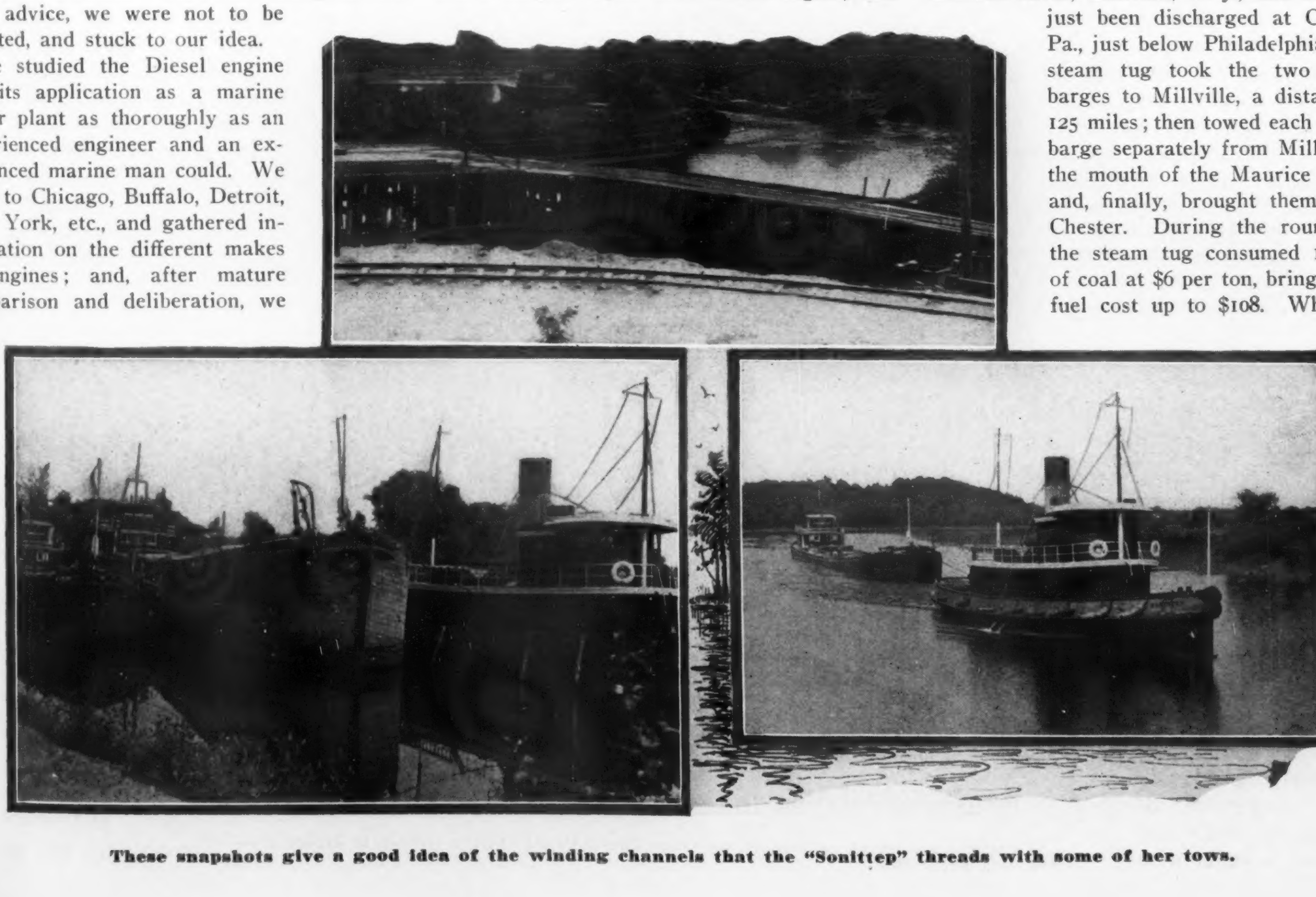
YES, I as the owner and Jim as the marine superintendent of a fleet of barges and steam tugs had to do something, and do it before it was too late. Wages were going up together with coal, repairs, food, and everything else that pertained to boating; but boat freights, charters, and profits, alas! did not soar along with the other things. As the distance between these two items increased, Jim and I got sorer in proportion. Something had to be done, as things seemed to be going down, and it looked as if we were headed for Davy Jones' locker.

We discussed larger and more efficient steam tugs, but found we could not in this wise cut down the number of the crew, although we might cut down on the proportion of coal used per horsepower. The other expenses stood just the same. Finally, in the midst of our discussions, the big idea struck us, "What is the matter with building a Diesel-engine tug." We first asked our boating friends what they thought of the idea, and the answer we generally got was, "To —— with the internal combustion engine: it is not there when you want it, and you must have a reliable machine at sea. Better stick to the old reliable steam engine and boiler and be safe." Notwithstanding all this sage advice, we were not to be diverted, and stuck to our idea.

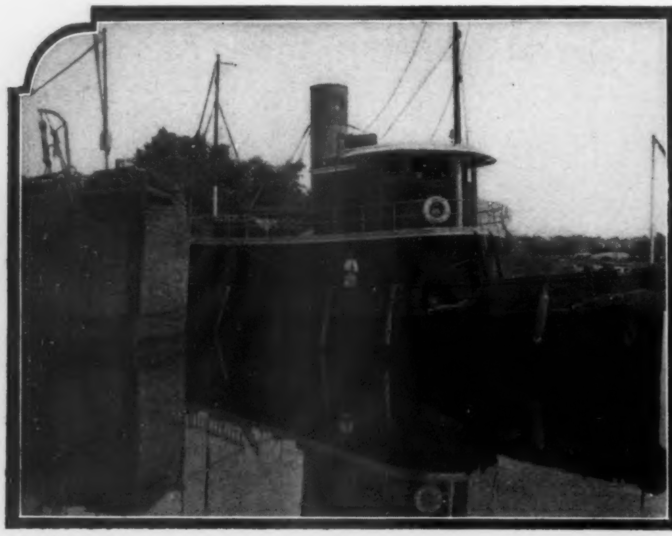
We studied the Diesel engine and its application as a marine power plant as thoroughly as an experienced engineer and an experienced marine man could. We went to Chicago, Buffalo, Detroit, New York, etc., and gathered information on the different makes of engines; and, after mature comparison and deliberation, we decided that the Ingersoll-Rand engine was a happy medium between a high-pressure Diesel and a simple 2-cycle semi-Diesel engine, and also a better designed engine than any we had studied. We went up the Hudson River to Hudson, where we found a ferry boat, plying between Hudson and Athens, with a 240-H.P. Ingersoll-Rand Diesel engine installed. We were so surprised with the workings of this engine and the satisfaction it had given that we decided then and there to build a tug and to equip it with an I-R engine.

The die was cast, the Rubicon was crossed, and we took the gamble in the face of what our boating friends advised. We secured a good marine designer, who was put under the direct charge of Jim. We had a Delaware River shipbuilding company build the hull, and Jim took care of the rest. The result was a splendid tug, equipped with a 320-H.P. Ingersoll-Rand Diesel engine, completed in August of 1923.

At that time we had several steam tugs handling our barges, and we were most anxious to test out the Diesel tug with our best steam tug in regard to full operating costs under similar working conditions. So we selected four of our 900-ton barges, all of which were built on the same lines. Two were loaded at our Silver Run wharf on the Maurice River, Millville, N. J., and two had just been discharged at Chester, Pa., just below Philadelphia. Our steam tug took the two empty barges to Millville, a distance of 125 miles; then towed each loaded barge separately from Millville to the mouth of the Maurice River; and, finally, brought them up to Chester. During the round trip the steam tug consumed 18 tons of coal at $6 per ton, bringing the fuel cost up to $108. When the



These snapshots give a good idea of the winding channels that the "Sonittep" threads with some of her tows.



Tugboat "Sonittep" standing by a tow and also underway.

two barges at Chester were discharged, we had the Diesel-engine tug tow them to the Silver Run wharf at Millville and take the two loaded ones up to Chester—in other words, cover the same mileage and do the same work as the steam tug. The Diesel tug consumed 864 gallons of fuel oil at 5½ cents per gallon, which made a fuel cost of $47.52 as against a fuel cost of $108 for the steam tug.

Jim did a little bragging about this performance among our boating friends in the office of one of the largest tug owners in Philadelphia, and "Paddy" said, "Look here, Jim, I can take my steam tug *C* and pull your darned Diesel tug all over the harbor, and I have $500 to back it up." "You're on," says Jim, and then and there it was decided to have a try-out between the two tugs on September 9, 1923, the day the Vessel Owners and Captains Association was to charter the steamer *Queen Ann* for its annual outing. The steam tug *C* was a larger boat with a 15x30-inch, fore-and-aft, compound engine, 150 pounds steam, and drew 13 feet of water while ours drew 8½ feet.

We went up just above the Pennsylvania Railroad bridge over the Delaware River, and fastened the sterns of the tugs with a 200-foot hawser—placing them across the river so that neither would have the advantage of the tide. The steamer *Queen Ann*, with 300 vessel owners and captains aboard, pulled up alongside to see the fun; and most of the betting was against the Diesel tug. When the signal was given, the steam tug got under way first, and a shout went up from the *Queen Ann* when the steam tug began to pull us. But when the Diesel engine got under full way she checked the momentum the rival tug had gained, and we started to pull the steam tug. We kept this up until they cried quits. It surely was a demonstration not to be forgotten. After a trial of five months with the Diesel tug, we found that the operating expense, as compared with the steam tug and on the same class of work, was 60 per cent. of the cost of the steam tug.

On the strength of this performance, I decided to build another tug of the same horsepower; and the *Sonittep* was finished May, 1924, to work coastwise from Delaware River points to Boston and return. In good weather, this tug averaged three round trips a month—taking two 900-ton barges, loaded with molding sand for steel castings, to Boston in 72 hours and bringing back two barges, light, to our Silver Run wharf at Millville in 56 hours. The *Sonittep* takes aboard in her tanks enough fuel oil for three round trips; and as she does not have to stop at New York for water and coal she saves at least 24 hours each way. In the course of a year, the fleet moves 100,000 tons of sand.

During the period of the *Sonittep's* service—which has been virtually continuous since she was commissioned—the boat has never had a lay-up on account of her engines. There have been stretches when I did not see the engineer for six months at a time; and what little was needed in the way of accessories was sent him at either end of the boat's run. Our average yearly bill for replacing engine parts on each of our oil-engined tugs has not exceeded $100. Incidentally, I might say that these tugs will maneuver as responsively as any steam-operated boat that we have employed. Furthermore, it is interesting to note that it takes only about ten minutes to get a boat like the *Sonittep* ready to start after a more or less protracted standstill where formerly it took fully two hours to raise sufficient pressure to get a steam tug away from the dock.

The prime mover of the "Sonittep" is a 320-H.P. oil engine, which is direct connected and reversible.

The *Sonittep* gave the same good service in 1925 that she did in 1924; and during the past winter she was down in Florida transporting lumber from Jacksonville to West Palm Beach, a run of 300 miles, and with no harbors between those ports. The tug covered the run between those points, with two loaded barges, five times during the interval between January 1 and February 15 of the current year.

Last fall, on one of the trips from Philadelphia to Boston, the 320-H.P. *Sonittep*, with 7 men aboard and towing two 900-ton barges, put out

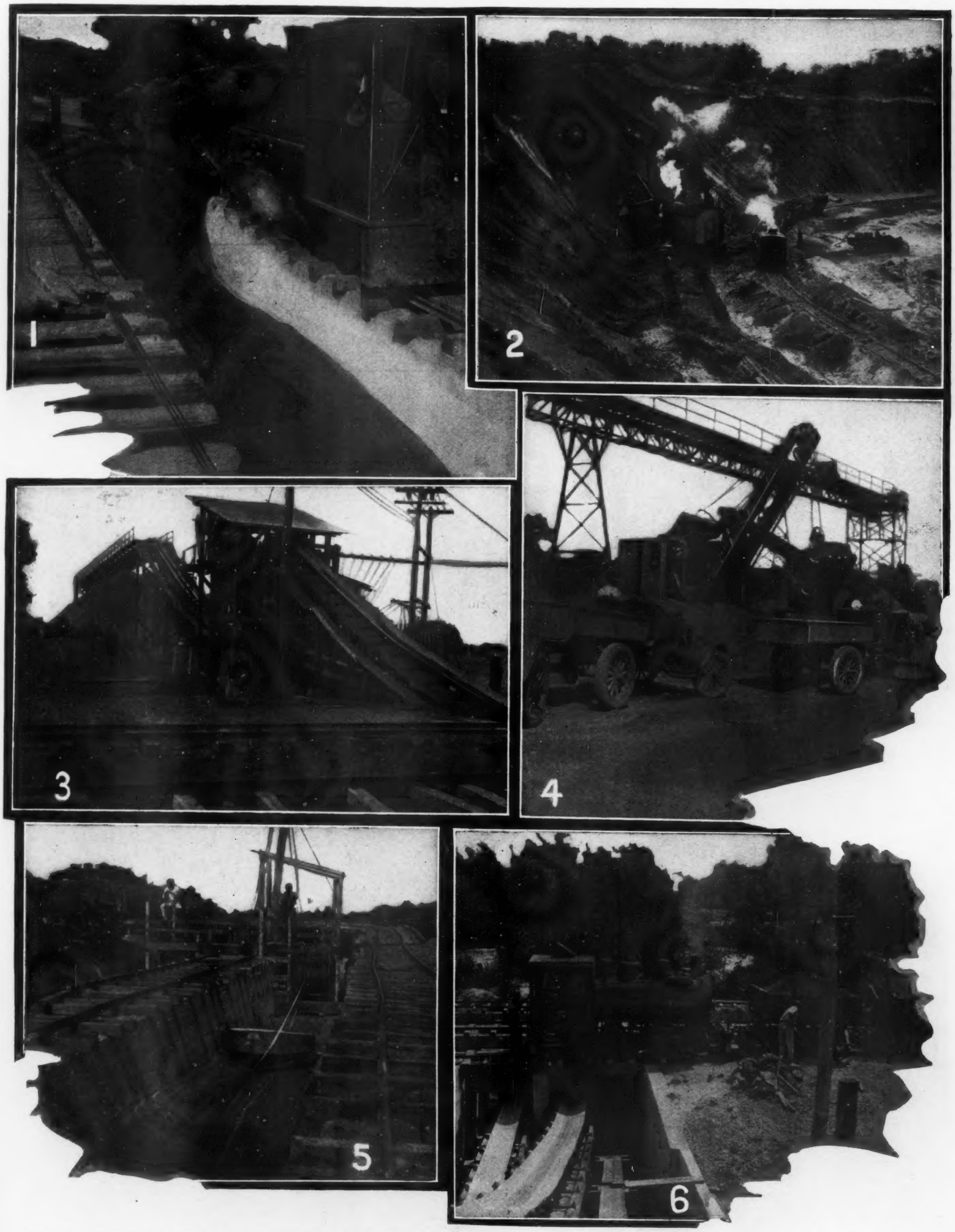


Fig. 1—Dumping a trainload of sand in one of the concrete trenches from which the sand is scraped on to conveyer belts.
Fig. 2—In one of the big sand pits where cars are loaded by steam shovels.
Fig. 3—Screens through which the sand passes for grading.
Fig. 4—Loading motor trucks from the sand stock pile.
Fig. 5—A drag-line scraper in each concrete trench serves to carry sand to a belt conveyer.
Fig. 6—Close-up of belt conveyers running from the dumping trenches to the screens.

from the Delaware Capes within half a mile of the Philadelphia & Reading tug *Lenape*—a boat of 1,200 H.P., with 24 men aboard, and towing two 2,500-ton barges and one 1,500-ton barge. These barges were equipped with masts and sails which helped when the wind breezed up. The *Sonittep* and the *Lenape* were never more than a mile apart during the entire run, and they were bow to bow at a point between Cape Cod and Boston, at which point the *Lenape* bore off toward Portland, Me., while the *Sonittep* proceeded into Boston.

To me, this seemed a wonderful performance against odds, and I feel that I should mention it now. Yes, we thought we were taking a gamble when we built a tug and fitted it with an Ingersoll-Rand oil engine, but we won; and, what is more to the point, I am at present building a larger tug in which we will put a larger Ingersoll-Rand oil engine. This time, I know that the undertaking is not a gamble, and I shall name the boat *Samson*.

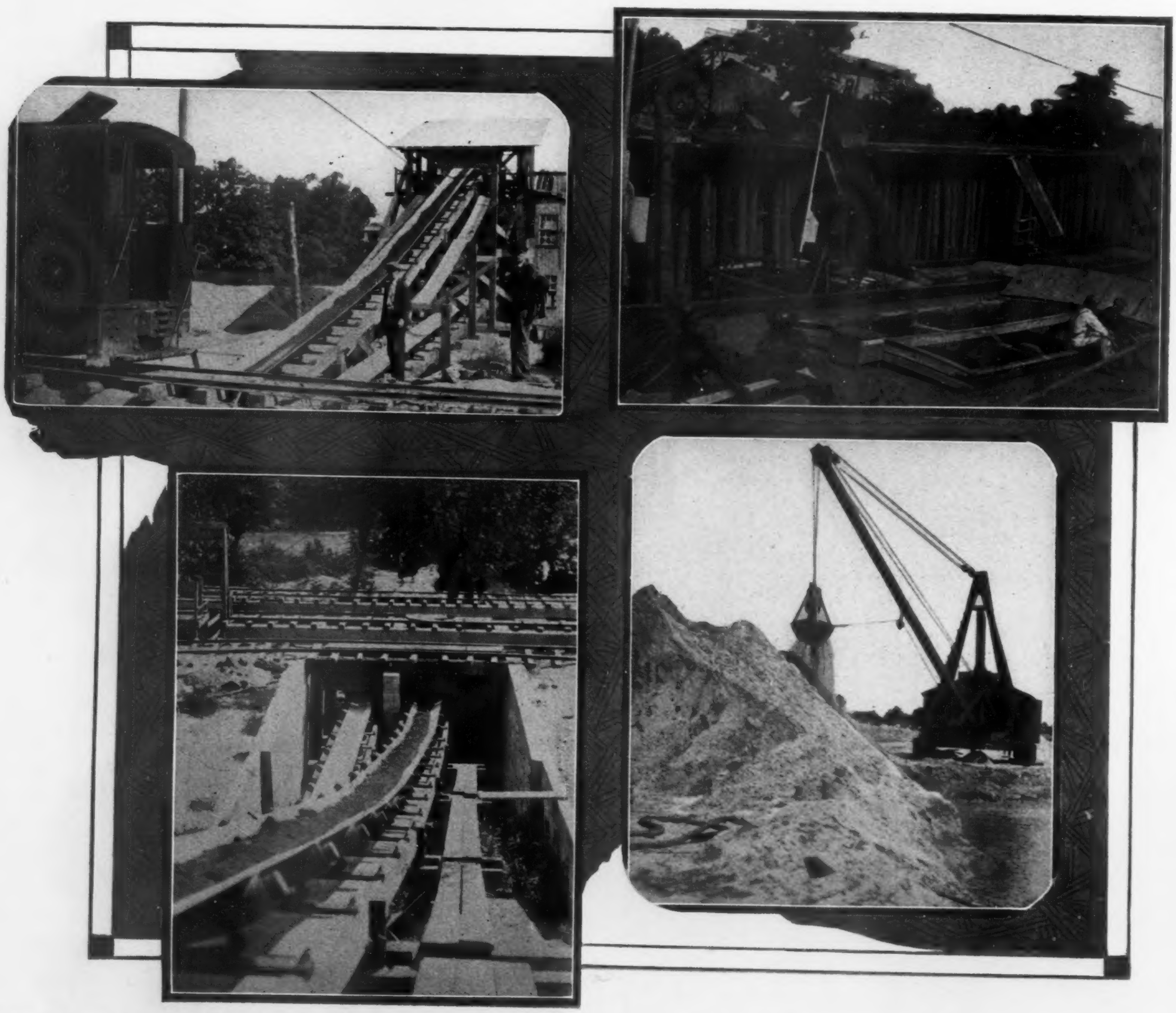
SOUND ABSORBENT PLASTER

"NOISE is the curse of modern hospital construction," says a prominent hospital official; and in response comes the announcement of a plaster that is said to be from 8 to 10 times as sound absorbent as ordinary plaster.

The interior of a modern building, with its smooth, flat, hard surfaces, is an almost perfect reflector of sound. In fact, ordinary masonry walls are much better reflectors of sound than the best of mirrors are reflectors of light. A mirror reflects about 90 per cent. of the light energy, but a tile wall with hard plaster reflects 97 per cent. of the sound energy. It has been proved that a sound of normal intensity must undergo about 450 reflections before it becomes inaudible—remaining in a room for 4.8 seconds before it is all absorbed.

A carpet on the floor will absorb 25 per cent. of the sound and reflect 75 per cent. But carpets and wall draperies are not permissible in a hospital. Comparative tests have been made of a room with the customary plastering on the walls and of a kindred room coated with the absorbent plaster. The difference in the acoustics was found to be remarkable.

For the purpose of the experiments, there was used a small portable pipe organ, with constant wind pressure, and a special chronometer to measure the sound duration. The sound-absorbing property of the new plaster is found to be much greater for tones higher than 512 vibrations per second, tones that are similar to those emitted by patients crying in pain or by infants. Hence the material is especially suitable for the walls of hospitals.



Top: Left—Belt conveyer moving sand from dumping trench to screens. Right—Barges at the dock loading with sand. Bottom: Left—Close-up of double belt conveyer that delivers sand to the screens. Right—Clamshell bucket dredging subaqueous sand.

During the six and a half years that have passed since the first trials were made in France in connection with commercial aviation, the traffic handled by French lines has increased steadily. In 1919, flying machines covered 165,000 miles as against approximately 3,000,000 miles in 1925.

Utah Is Now Making Iron

Fine Pig is Produced at Ironton Which Has Become an Important Metallurgical Center

By R. G. SKERRETT

UTAH is developing her own iron resources; and there is no reason why the state should not some day become self-sufficient in meeting her demands for iron and steel. Indeed, it has been suggested that Utah ultimately may be able to furnish ferrous materials to many of her neighboring states—such being her abundant wealth in deposits of iron and coal.

Relatively few of the public at large are aware that Utah has rich and readily workable deposits of iron ore; and even a smaller number is aware that there is an up-to-date and active plant between Provo and Springville, Utah, that has turned out as much as 431 tons of marketable pig in the course of a day. The significance of that blast furnace can best be understood if we quote the official immediately in charge of the plant. As Mr. Phibb expressed it: "A country can't be strong without iron and steel—that is what Utah and this section of the United States has long needed. Now the state and the region can push forward with its own resources."

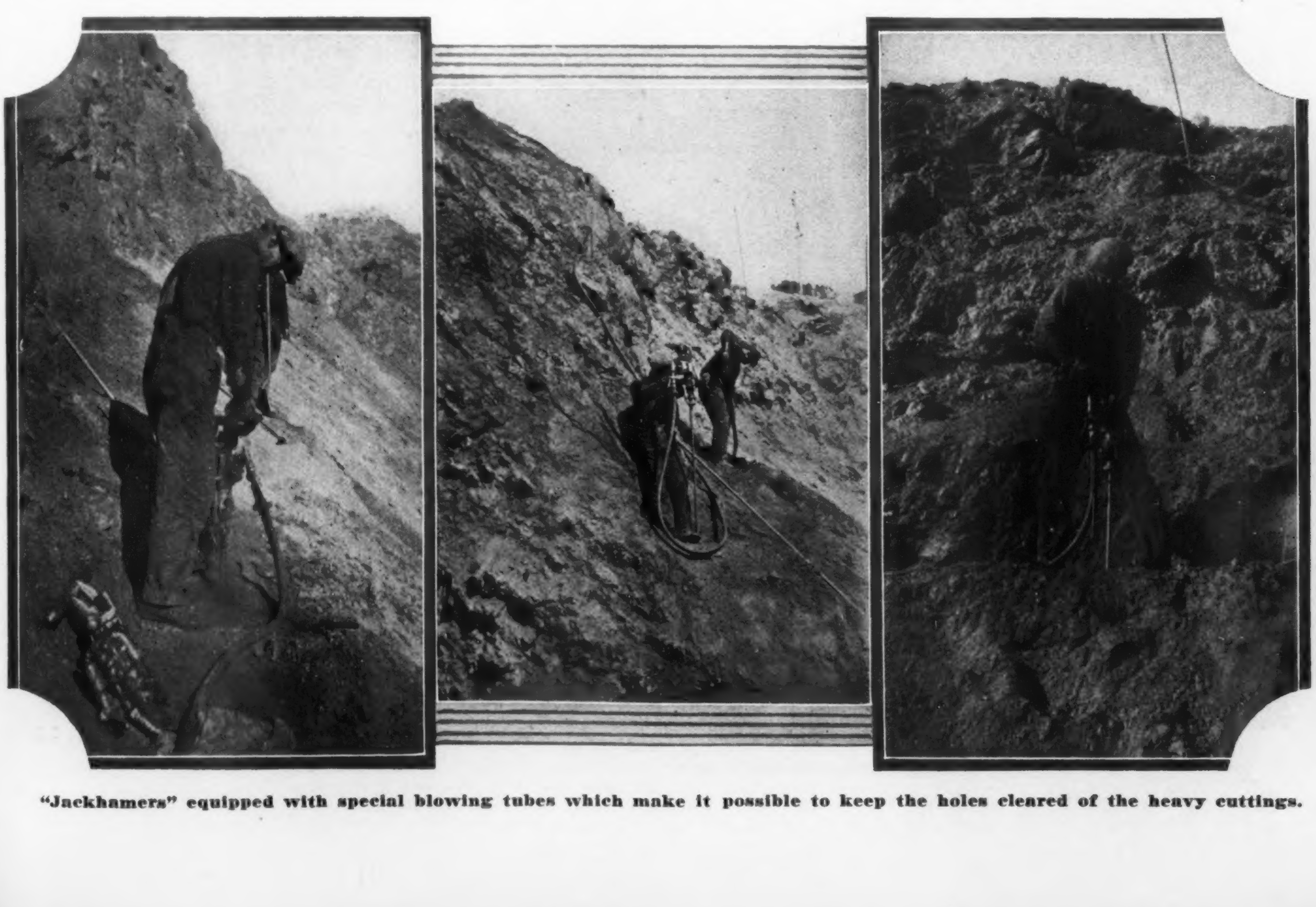
The plant of the Columbia Steel Corporation was built at Ironton in 1923, and began active operation on May 1, 1924. The iron ore treated at Ironton comes from deposits situated in Iron County, 250 miles away; the coal used at the plant is brought from a field that is 150 miles distant; and the limestone is obtained from outcroppings that call for a haul of only 40 miles. In short, all the essential minerals are obtainable within the state.

UTAH, with an area of substantially 85,000 square miles and a population of nearly 500,000, occupies a conspicuous position among the so-called Mountain Group of our states of the Far West. Despite her enormous mineral resources, Utah has in the past been obliged to obtain elsewhere whatever iron and steel she needed.

Two years ago, her enterprising citizenry took steps looking to her ultimate self-sufficiency in the matter of ferrous materials when the blast furnace at Ironton began turning out excellent pig. Utah is blessed with an abundance of first-class coking coal and enormous deposits of iron ore. In many ways the state will be economically stronger because of this new industry.

The coal mined at Columbia is from a vein ranging in thickness from 15 to 16 feet; and surveys have definitely established the fact that there are millions of tons of the fuel within reach. The coal is of a sort that makes excellent metallurgical coke, which augurs well for the future of the industry in Utah. The iron ore utilized by the Columbia Steel Corporation at Ironton is mined at Iron Springs; and interesting particulars regarding the deposits there have been disclosed by Capt. Duncan MacVichie in a paper read by him last year at a meeting of the American Institute of Mining Engineers. The iron fields at Iron Springs and in the Pinto mining district are extensive and rich; and, broadly stated, the ores are combinations of hematite and magnetite—an average analysis showing 58 per cent. iron, 5 per cent. silica, .20 per cent. phosphorus, and 3 per cent. moisture.

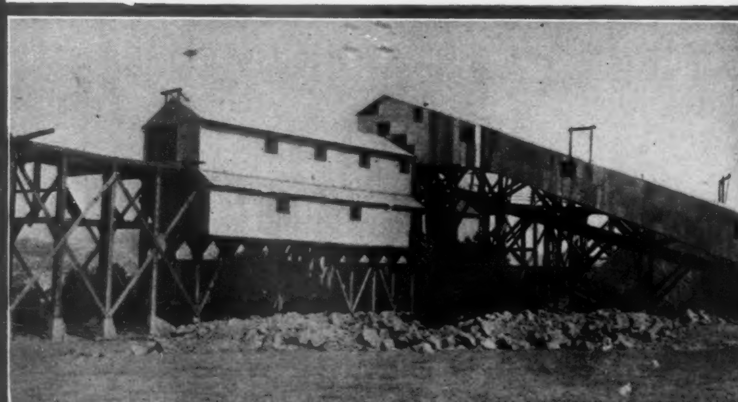
According to Captain MacVichie: "Mining at Iron Springs at the present time is carried on by the open-pit system. A tunnel has been driven under the known ore bodies, and raises put up to the surface. The ore is broken



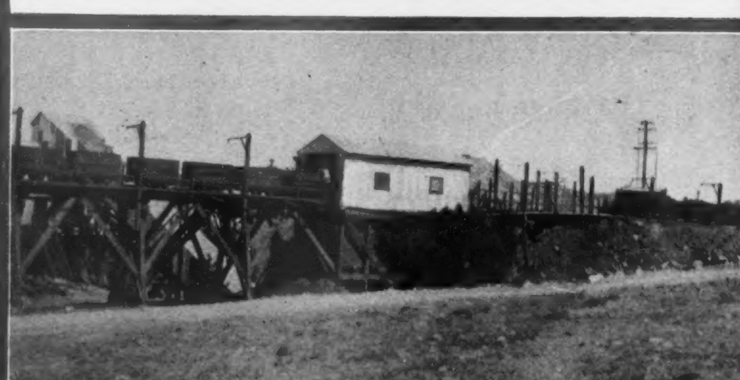
"Jackhamers" equipped with special blowing tubes which make it possible to keep the holes cleared of the heavy cuttings.

Bunk house at the iron mines.

Mining property at Iron Springs.



Ore bins at Iron Springs.



Crushing plant at the mines.

around the raises and drawn through chutes, at tunnel level, into cars of 4-ton capacity. The cars are hauled by electric locomotives to the crushing plant near the portal of the tunnel. From the crushing plant, the ore is transported on a belt conveyer to the receiving bins, from which it is discharged into standard-gage railroad cars. Under the present methods, many millions of tons of iron ore can be mined from the Iron Springs and Pinto fields before underground operations become necessary."

The system of mining employed at Iron Springs is of an exceptional character, and has been developed by the company in order to meet the conditions prevailing on the property. Some of our illustrations give a graphic indication of the practices followed. One picture shows the entrance to the tunnel already mentioned. This tunnel was driven under the ore bodies at a comparatively shallow depth, as the distance from the back of the tunnel to the surface exposure of the ore bodies varies from 60 to 90 feet. Raises were driven from this tunnel to the surface, and then a glory-hole system was adopted. Later on, these glory holes were connected so that the workings became, in appearance, a big ditch. The ore is first broken down by the bench or the quarry method—and one of our illustrations shows a 20-foot bench which was blasted out successfully. The blast holes were spaced approximately 6 feet apart, and had 4 feet of burden on each hole. The practice is to barrel-load the holes; they are then blasted; and the ore, which is a replacement of limestone, breaks up in pieces that range from fineness to large boulders.

The boulders are block holed or are broken by hand—whichever may be expedient, and afterwards the ore is dragged by horse scrapers over to the tops of the raises. The ore passes through the raises to chutes in the tunnel, where it is loaded into cars and hauled in trains to the crusher. Inasmuch as the broken ore packs very quickly on the ground at the mine, it is necessary, after a few drags have been made of the larger pieces, to plow up the remaining material so as to facilitate the work of the scrapers. Both left-hand and right-hand plows are used for this purpose.

Owing to the nature of the ground, drilling presented somewhat of a problem for a while. Now "Jackhamers" of Type BBRA-13—which are equipped with an excellent blowing device—have been found admirably suited for the work. These machines have been used to drill holes to a depth of 20 feet and to blow them free of the heavy cuttings the while. The depth of the holes has been limited so far to 20 feet only because longer steels have not been employed with the "Jackhamers."

From the mines at Iron Springs, the ore is hauled over the Los Angeles & Salt Lake Railroad to the blast furnaces at Ironton—about 50 miles south of Salt Lake City, where the ore is handled by a single up-to-date 400-ton blast furnace. As a matter of fact, all the equipment and all the operations at Ironton are essentially up to date; and the aim in all departments of the plant is to insure efficiency

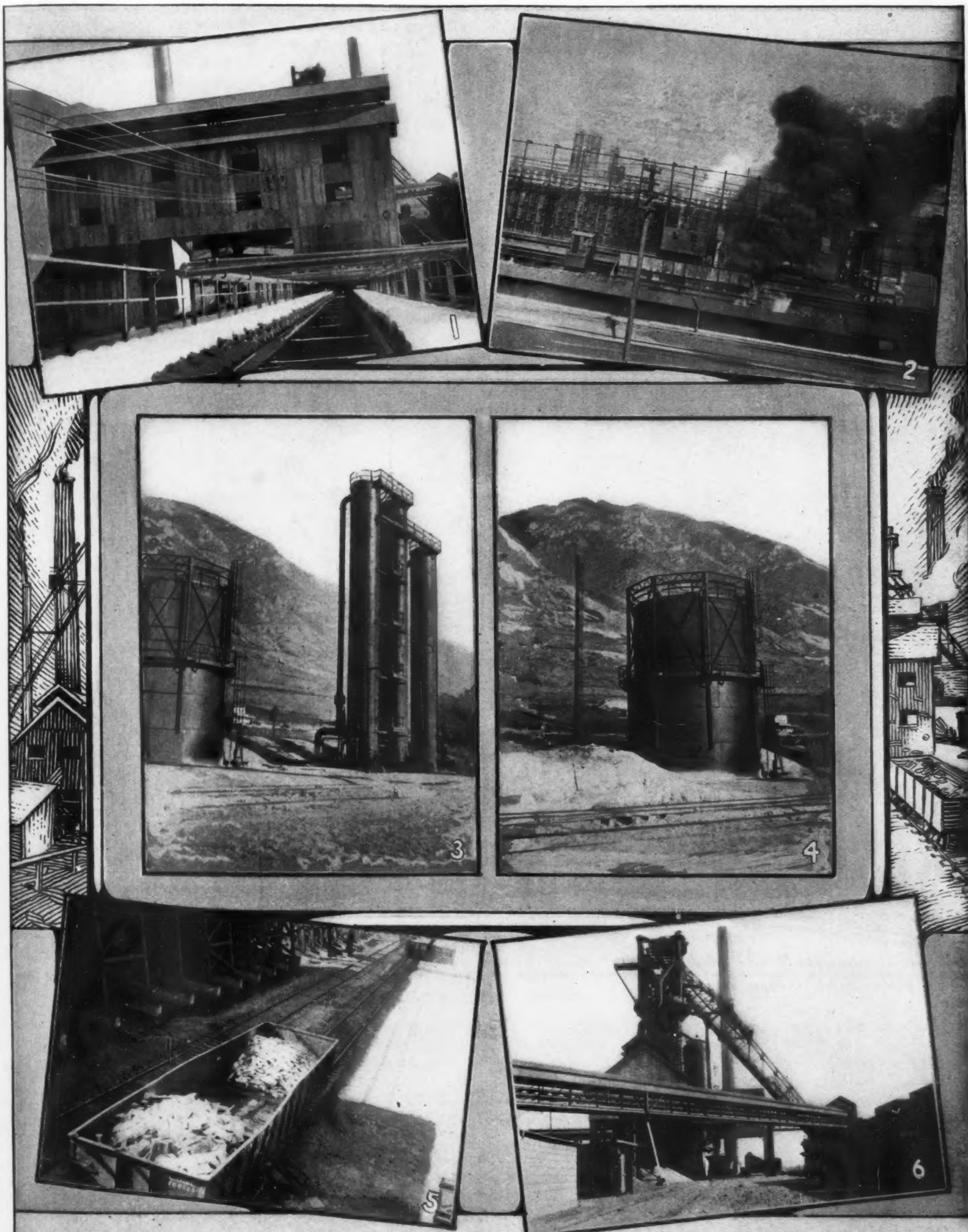
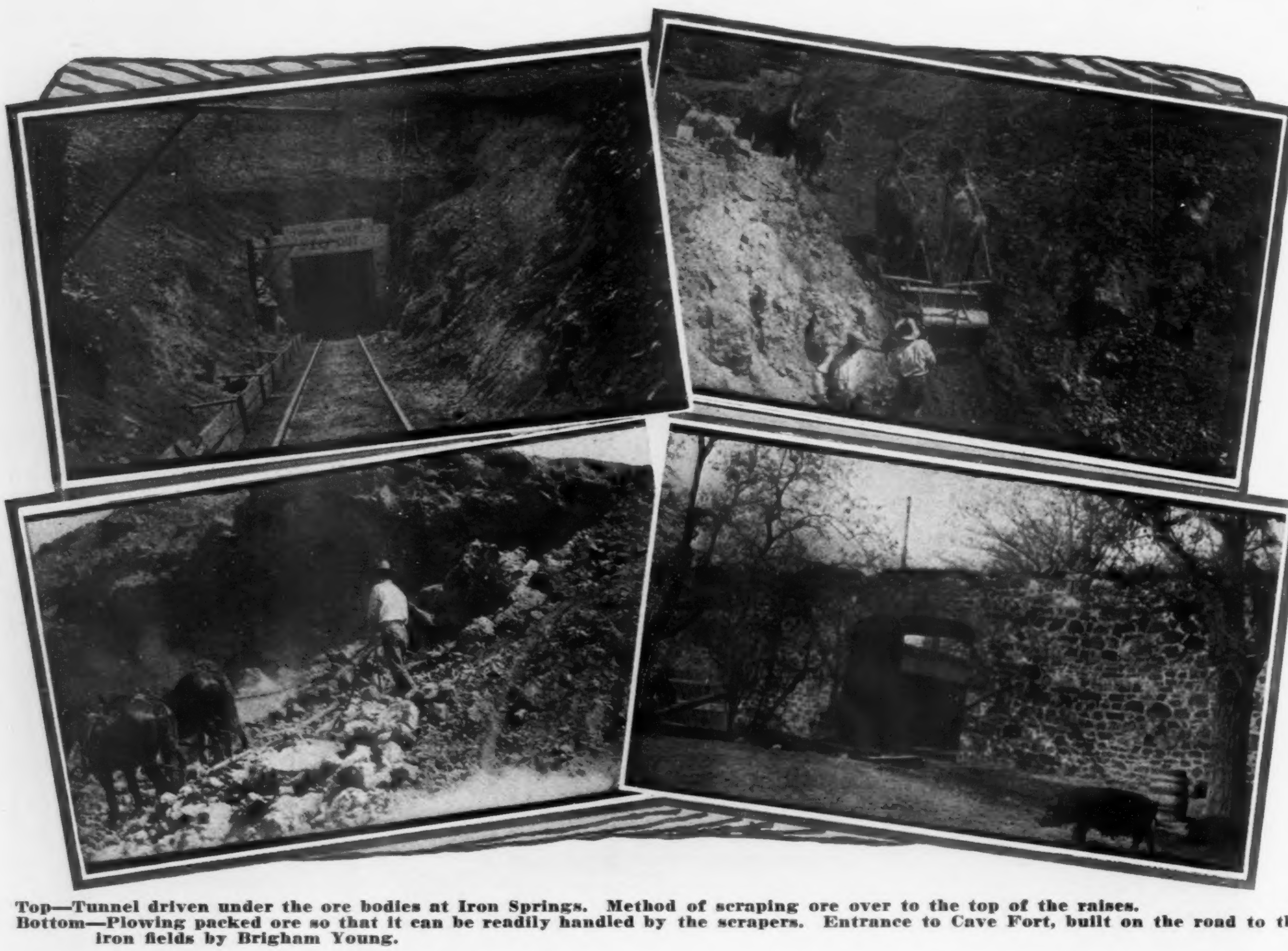


Fig. 1—Pig-casting machine.
Fig. 2—Pushing out coke from the by-product ovens.
Fig. 3—Scrubber towers through which the gas is passed for treatment.
Fig. 4—Gas tank at the Ironton plant from which Provo is supplied.
Fig. 5—Steel car partly loaded with pig iron made at Ironton.
Fig. 6—The 400-ton blast furnace at Ironton.

and economical results. The ore carries from 55 to 60 per cent. iron.

Air for the blast furnace is supplied by two Ingersoll-Rand turbo-blowers—only one machine being used at a time. Each turbo-blower has a capacity of 42,000 cubic feet, and at the normal rate of operation furnishes air at a pressure of 17 pounds to the square inch. This pressure can be increased to 25 pounds, if furnace conditions require it. The blowers have performed perfectly since they were installed, and the engineering department is outspoken in its commendation of these essential units.

Originally, the valves in the discharge line



Top—Tunnel driven under the ore bodies at Iron Springs. Method of scraping ore over to the top of the raises. Bottom—Plowing packed ore so that it can be readily handled by the scrapers. Entrance to Cave Fort, built on the road to the iron fields by Brigham Young.

from the turbo-blowers were opened and closed by hand—either operation requiring 300 turns which took several minutes of fairly hard work to complete. Subsequently, an air-driven 11-B drill, fitted with a key wrench, was adapted for this service; and, inasmuch as the drill makes 360 revolutions a minute, the opening or the closing of one of these valves can now be accomplished easily and in a fraction of the former time. The point to be kept in mind, in order to appreciate the service rendered by the drill, is that there are two turbo-blowers and two discharge lines. Therefore, the discharge line on the blower that is to be started must be opened quickly and, correspondingly, the line on the machine shutting down must be closed just as quickly.

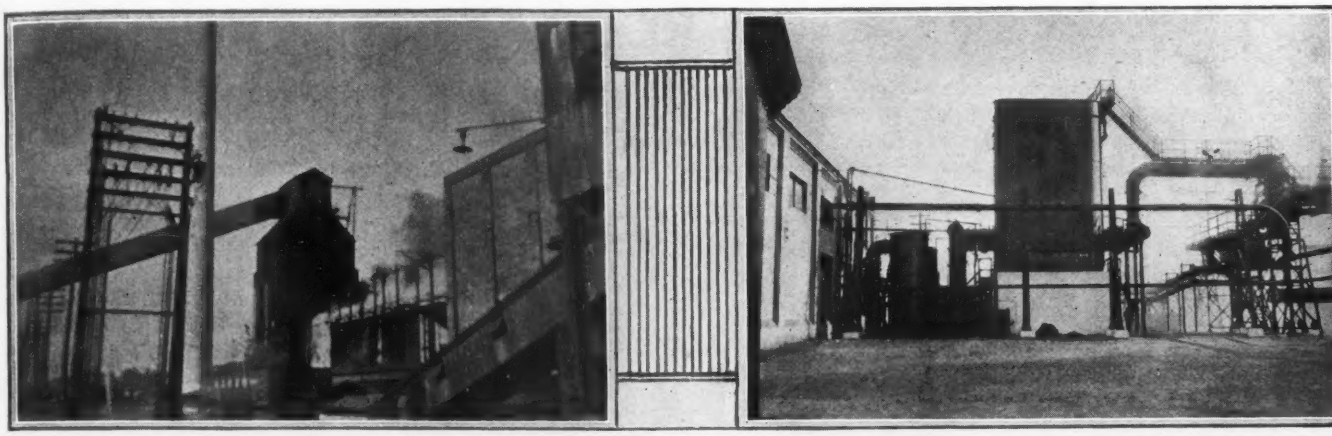
The valve-closing motor is mounted on a frame having four legs, and these legs fit into holes provided for them in the engine-room floor. The air-drill motor is connected to the valve stem, through the floor, by means of an extension socket. After operating the valves, the frame is removed and put out of the way. The equipment has been in service ever since August of 1924, and the motor has needed no repairs in the meanwhile. The cost of this air-driven outfit was several hundred dollars lower than any other power-operated apparatus that could be employed in its stead.

The power plant, which is steam driven, is equipped with two I-R barometric condensers—one of which serves the turbo-blowers and the other takes care of the exhaust steam from the General Electric generator set which produces all the current used on the premises. These condensers are able to pull a 25-inch vacuum at the local altitude of 3,800 feet.

The pig iron is turned out by a pig-casting machine, and this machine is electrically operated. The bulk of the pig is shipped to two points on the Pacific coast—namely, to Pittsburgh, which is just outside of San Francisco, and to Torrance, which is on the outskirts of Los Angeles.

All coke used at Ironton is made there in by-product ovens of the Becker type, and the gas from the ovens is subjected to treatment for the recovery of ammonium sulphate, benzol, and tar before the gas is used for fuel in the coke ovens or pumped into the distributing main which runs to the neighboring town of Provo. The order in which the gas is handled to clean it and to recover valuable by-products is as follows: the gas first goes through the tar-removing equipment; next, it is treated to recover the ammonium sulphate; and then it is run through the scrubber towers where the benzol is extracted. In the gas department, there are four XB-2 compressors, which are cross-compound, 2-stage machines having cylinders, respectively, of 9 and 14 inches in diameter and a stroke of 12 inches. These machines are run as single-stage, duplex compressors; and they pump gas first to the creosote plant and then serve as boosters in forcing the gas through the service main to Provo. Thus the gas, which is a by-product of the coke ovens, is used as a fuel in those ovens and the surplus is marketed in a nearby town.

The operation of the booster compressors is governed by Tagliabue compressed-air control apparatus, and in this way the gas pressure in the line to Provo is held uniform under different service demands. In fact, compressed air is utilized in a variety of ways at the



Left—Coal tipple and by-product coke ovens. Right—Stills and tar-extraction plant.

Ironton plant—for instance, a steam hoisting engine is run with compressed air; the tipping of slag pots to dump their contents is done pneumatically; all electric motors are blown clean with compressed air; the gates in the coke bins at the blast furnace are opened and closed pneumatically; the electric locomotive used at the coke quenching station is equipped with an air compressor to operate dump cars and grates; the apparatus used in pushing coke from the ovens—that is, dumping the coke from the ovens into the cars, is done by means of compressed air; and compressed air is utilized to clean boiler tubes and to drive drills and other pneumatic tools employed more or less extensively in and about the plant for routine work, for making repairs, and in making improvements. Much of this necessary air is supplied by an XRB compressor, which is belt driven from an electric motor. This machine provides service air at a pressure of 85 pounds per square inch.

This survey of the activities at Ironton and in the associate iron and coal fields does not include many details that might be of interest, but it does make it plain that wide-awake men in Utah are alive to what that section of the country needs in the way of a source of iron and steel within the State's own borders, and tells what steps they have taken towards her ultimate self-sufficiency in this respect.

ALARM FOR COOLING-WATER SYSTEMS

AN INGENIOUS mechanism known as the Monitor Safety Device, which has recently been put on the market in this country and Great Britain, automatically warns an operator by either whistle or electric bell when the cooling-water system of an oil engine is not circulating as it should in order to keep the engine at a proper temperature.

It is claimed that the cracking of cylinders and the drop in the power output of an oil engine are, in the majority of cases, caused by the slowing up of the flow in the cooling-water system. The reason for this slowing up is sometimes due to the fact that cooling water must be circulated again and again, as it is not always possible to obtain enough water for this purpose at a low cost. Naturally, after repeated journeys around warm cylinders, the water loses its effectiveness as a cooling agent —and the engine suffers.

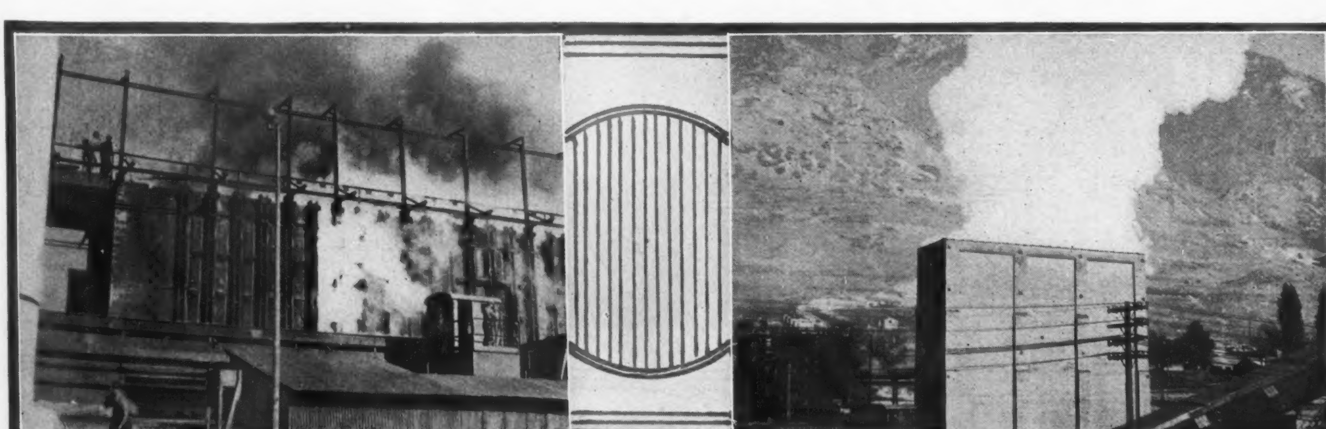
The Monitor Safety Device is said to give instant warning when the water rises to a temperature that might prove harmful to the engine, or even disastrous. This automatic alarm, according to the manufacturer, has several good features. Among these are: free movement of the spindle without leakage; a flow indicator that shows the flow of water through the pipe; adaptability—it can be used for both vertical and horizontal pipe lines; and, last but not least, the device automatically resets itself after an alarm has been sounded.

MORE ELECTRICITY PER POUND OF COAL

THE output of electricity by public-utility power plants in the United States in 1925 was 65,801,000,000 kilowatt-hours, an increase of 11.5 per cent. over that of the preceding year. About 34 per cent. of this total was obtained from falling waters—representing a slight increase over the power so produced in 1924. Had coal been used instead of water power to generate this 34 per cent. of electric current, then 23,000,000 tons would have been required.

The amount of coal consumed in producing electricity in 1925 was only 7 per cent. greater than that burned in 1924, but the quantities of fuel oil and gas consumed were 38 per cent. and 4 per cent. less, respectively. But to give the reader an idea of the fuel needs of the power plants under consideration, let us put the figures in a concrete form. By adding to the coal actually burned the coal equivalent of the oil, gas, and wood used for the twelvemonth, then we learn that an average of 3,000 pounds of coal was consumed per second.

The gain in efficiency in the use of fuel continued throughout 1925. As compared with 1924, there was a decrease of about 0.1 pound in the average consumption of coal per kilowatt-hour. While this gain may seem small on the face of it, nevertheless it represents a saving in coal of more than 2,000,000 tons for the year.



Left—By-product coke ovens. Right—Quenching tower in which a newly withdrawn carload of coke is being quenched.

CLOSE GAP IN HETCH HETCHY AQUEDUCT

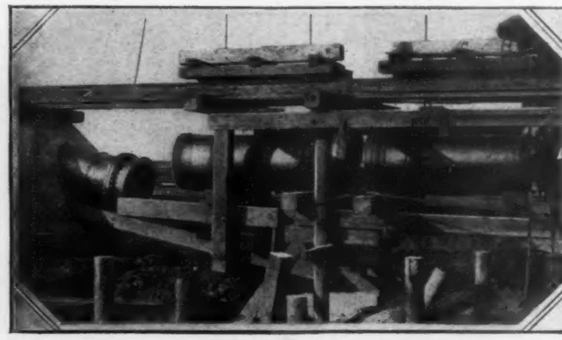
By C. W. GEIGER

HAVING overcome the various obstacles along the land route by which the Hetch Hetchy system is to convey water from the mountains to the distributing mains of San Francisco and vicinity, one of the last links in this monumental undertaking was completed with the laying of the main which forms what is known as the Bay Crossing Division.

This section of the water-supply system begins at the Irvington gate house, from which point the water will be diverted through three branches: one, reaching southward to San Jose and the Santa Clara Valley; another, extending northwest to Oakland and other east bay cities; and the third, with which we are to deal in this article, leading west by way of San Francisco Bay to the San Francisco peninsula. This main branch has a daily capacity of 200,000,000 gallons, and discharges into the Crystal Springs Reservoir.

The Bay Crossing Division extends from Irvington to a point 3 miles west of Redwood City, and throughout the greater part of its length—19.4 miles—is made up of steel piping having an inside diameter of 60 inches and varying in thickness from $^5/_{16}$ to $^7/_{16}$ inch. Starting near Irvington, at an elevation of 52 feet, the pipe line runs underground for a distance of 6 miles, gradually descending to the edge of a salt marsh near Newark. Over this marsh, the line is carried for 1.7 miles on a timber-pile trestle to Newark Slough—the crossing of the slough being effected by means of a cast-iron submarine pipe 42 inches in diameter and about 400 feet long. Thence, to the east shore of Dumbarton Strait, a stretch of 1.4 miles, the 60-inch piping is laid over another timber-pile trestle, while 2,800 feet of the 42-inch submarine piping is used to negotiate the navigable channel of Dumbarton Strait. This section of the line extends to the eastern shore of San Francisco Bay, where it terminates at a concrete caisson having a diameter of 77½ inches.

From this caisson, the 60-inch pipe line is conveyed for a distance of 3,875 feet over a



Section of the 42-inch main which runs under Newark Slough and which is part of a 19.4-mile pipe line that links San Francisco with the Hetch Hetchy water-supply system.

steel bridge to the west shore of the bay, whence it is carried by way of a trestle, 2,700 feet long, to the Pulgas pumping station. From that point on the line is buried, continuing at a low elevation through Redwood City. The westernmost 2.1 miles of this section of the water-supply system passes through hilly country in and about the Cordilleras Canyon and is alternately laid in trenches and carried over gullies on steel bents—rising to an elevation of 278.5 feet where it connects with Pulgas Tunnel. This tunnel discharges into Crystal Springs Reservoir.

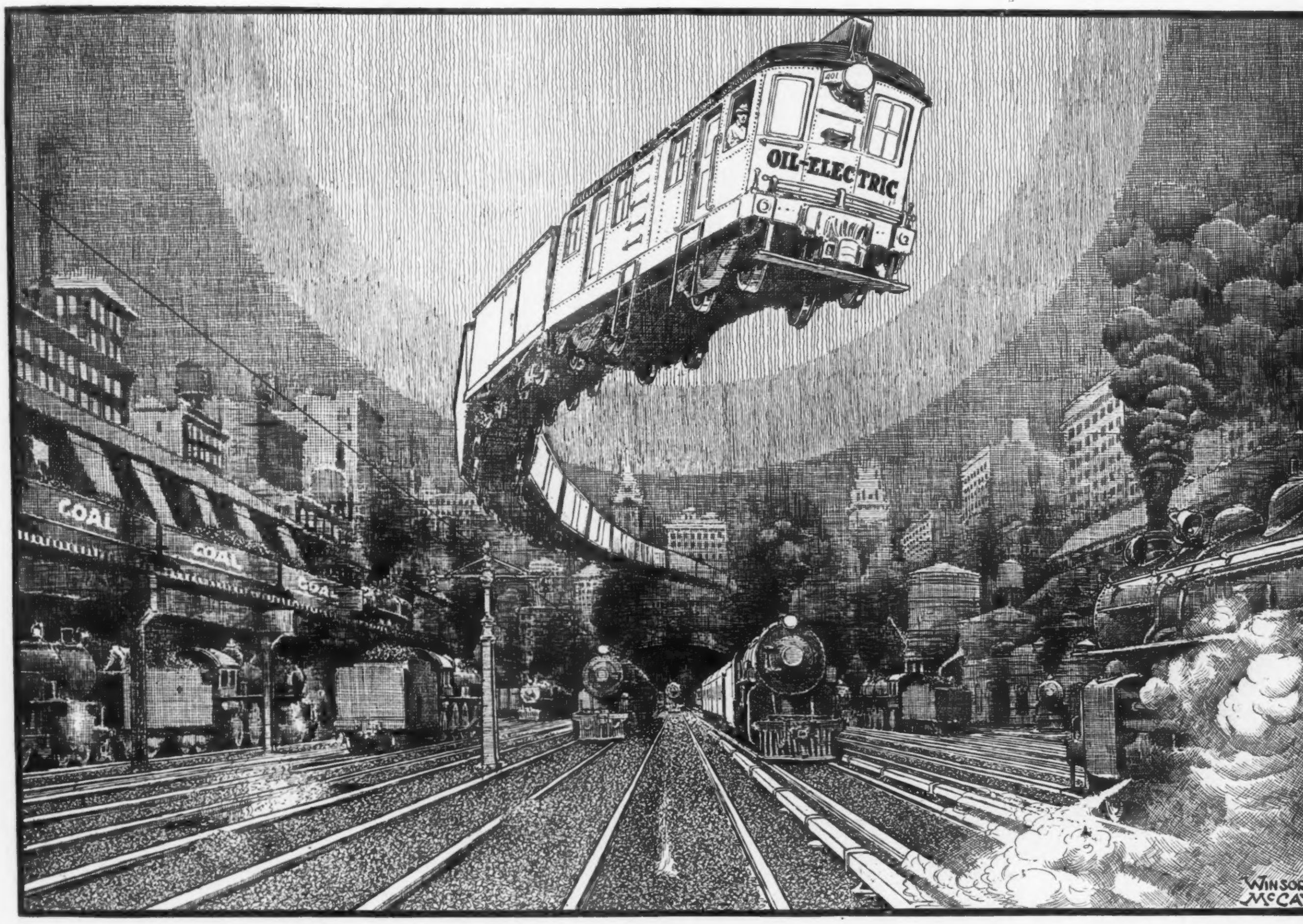
Each unit of the 60-inch piping was normally made up of four 8-foot segments, double-lap riveted, in the shop of the Western Pipe & Steel Company. Before leaving the shop, each section was tested for tightness with compressed air and then dipped vertically in a bitumen enamel. After having been laid, the line was once more subjected to a pressure test, using compressed air for the purpose. Wherever the piping ran underground, the trench was excavated with a bottom width of 6 feet and to a depth averaging from 7 to 8 feet—the sections being placed therein by means of a caterpillar type of traveling crane. In the course of a working day anywhere from 18 to 20 sections were laid, bolted, riveted, and calked.

When Newark Slough was reached, it was first necessary to build a track, resting on wooden piling, across the slough and along the line to be followed by the piping. The work of laying the 42-inch main proceeded about as follows: The pipe sections were taken out over the track to the point of use on 4-wheel trucks and were there picked up by a floating derrick and placed on a cradle. This cradle was supported by the same piling that carried the track but rested several feet below the track level. After all the units had been joined and properly calked on the cradle, clamps were secured about the pipe line at suitable intervals. Then the entire 400 feet of main was raised slightly above the cradle; the cradle was removed; and that section of the Bay Crossing Division was lowered into the water by the aid of threaded rods attached to the clamps and extending up through heavy timbers. In lowering the pipe line, a large crew of men had to be employed to operate the wrenches required to turn the turnbuckles on the rods.

Exports of fresh fruits from the United States in 1925 had a total value of $42,220,582, an increase of $904,316 over those for the preceding year. The growing demand for our apples, oranges, grapefruit, pears, etc., the world over is calling for a proportionate increase in cold-storage space aboard ocean-going steamships.

Left—Calking a joint in the riveted main.
Center—Testing a completed section of the riveted main with compressed air.
Right—Riveting a joint in the newly laid main.

How a Cartoonist Visualizes the Benefits Of the Oil-Electric Locomotive



THIS drawing by Winsor McCay, of the New York Herald-Tribune staff, is a notable example of the ability of an experienced cartoonist to tell—in a vivid, pictorial flash—a story which would otherwise require many pages of printed words. Such a cartoon has an added interest as an interpretation of a purely technical subject by one accustomed to reduce all problems to terms of human progress and comfort.

Before starting on this cartoon, Mr. McCay listened for more than an hour to the story of the development and accomplishments of the oil-electric locomotive, together with a somewhat detailed description of its mechanism. He was told of the great economies in fuel and maintenance costs which will be made possible for the railroads by this new type of motive power; of its freedom from smoke and noise; of its simplicity of operation; of its power; and of its easy adaptability to every branch of railroad service. It was explained that the oil-electric locomotive had ceased to be an experimental proposition in January, 1926, when it was in regular operation on four important eastern roads and had been ordered by five other lines in the East and Middle West. Performance records made in actual railroad service were described; and the reasons were given why so many engineering authorities regard the oil-electric locomotive as a supremely important new factor in the field of land transportation.

"And now, Mr. McCay," said the cartoonist's interviewer, "we are interested in getting your impression of an engineering development of this kind. From your broadly public viewpoint, from the angle of purely human values, just what seems to you to be the meaning of the oil-electric locomotive?"

Mr. McCay's response came instantly—but not in words. With a few swift strokes of a pencil, in less time than it takes to tell it, he flashed on a memorandum pad all the outstanding features of this cartoon. After that, the finished drawing, as reproduced above, became largely a matter of painstaking detail.

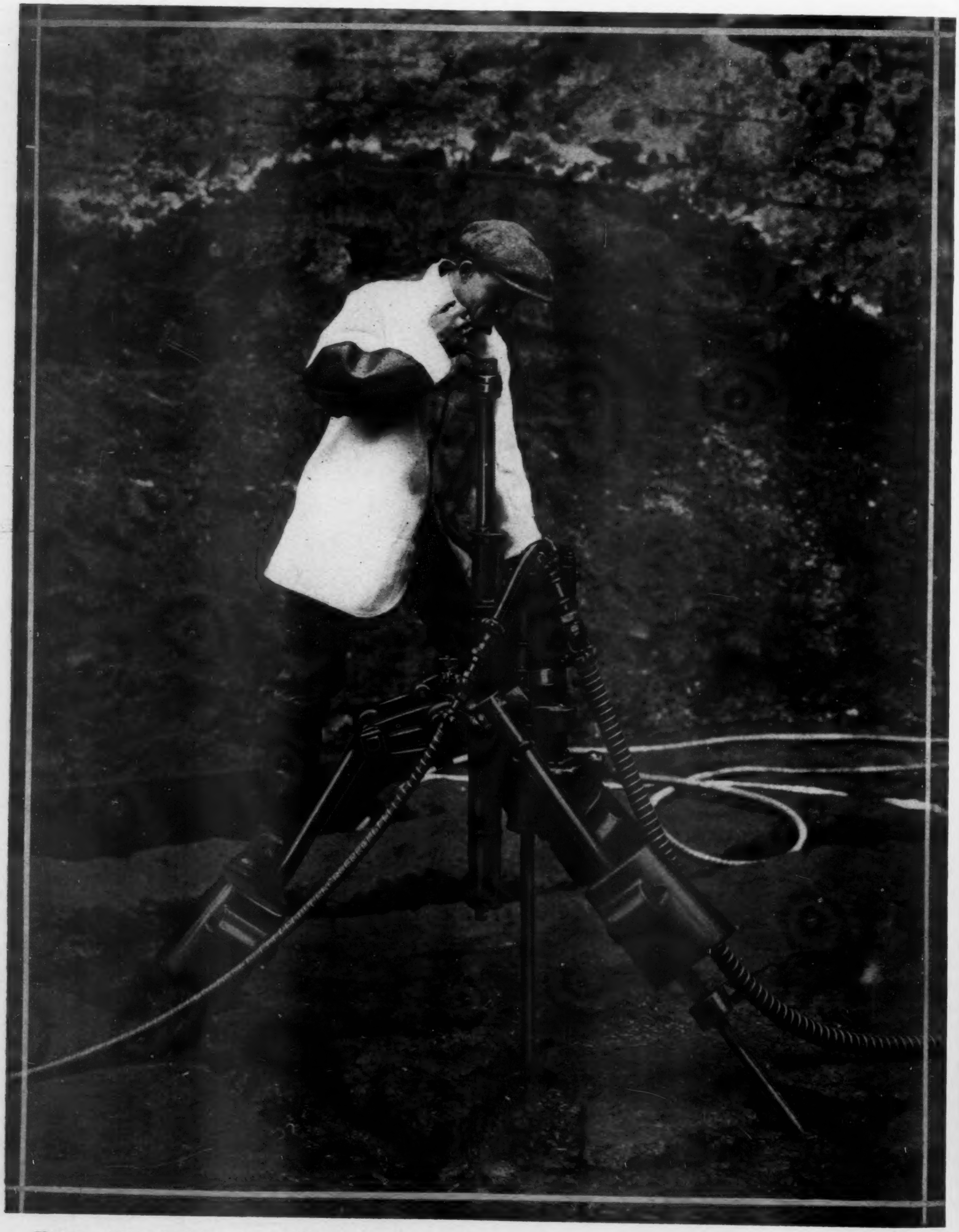
To Winsor McCay, the advent of the oil-electric locomotive meant the springing of railroad transportation from an age of noise and grime and fettered power into a bright new era of cleanliness and quiet efficiency.

CONCRETE VAULTS SAFER THAN STEEL ONES

ACCORDING to the president of the Architectural League of New York, concrete vaults are more resistant to the tools of a burglar than are vaults in which steel is counted upon to insure security against this form of attack.

As is well known, the intense heat of the oxy-acetylene torch is frequently used by safebreakers to burn through the steel defenses ordinarily forming the walls of such structures. After a series of tests, it was discovered that every form of steel lining employed in bank-vault construction failed before the attack of the oxy-acetylene torch. A well-built reinforced-concrete wall will offer more protection than the much more costly linings of steel plating.

In this connection, it is interesting to recall that the steamship *Teno* recently carried from Chile to New York gold bars to the value of $12,500,000. That bullion was placed within a vault, built of concrete, located in the hold of the ship. The vault was especially constructed to protect that consignment of precious metal.



Close-up of big tripod rock drill which formed one of the two central figures in the initial attack of the rock overlying the line of the new Mersey Tunnel.

Work Begun on New Mersey Tunnel

Rapid Growth of Liverpool and Adjacent Industrial Districts Has Necessitated This Great Vehicular Tube

By A. L. MURPHY

CONSTRUCTION of the world's largest subaqueous vehicular tunnel was begun on December 16, of the year gone. On that date, at 3.34 in the afternoon, H.R.H. Princess Mary turned a gold throttle lever and thus opened the line carrying compressed air to a group of concrete breakers. Those pneumatic tools started the excavating of a shaft from which a new tunnel will be driven under the Mersey River at Liverpool, England.

When completed, this tunnel will have an internal diameter of forty-four feet and be a little more than two miles long. Something like eight years will be required in which to finish the undertaking; and the estimated ultimate cost is put at approximately £5,000,000.

THE City of Liverpool, situated on the north bank of the River Mersey, is the second largest seaport in England and ranks among the largest ports in the world. Located as Liverpool is in relation to the huge industrial districts of Lancashire and Yorkshire, it is little wonder that its population should have increased rapidly as these industrial areas developed and expanded.

The rate of growth of the city can be gathered from the following facts. The population, which was estimated at from 60,000 to 70,000 people in 1800, reached a total of 246,000 in 1837 and 601,000 in 1881. Today, the inhabitants number well over 800,000. In 1895, the Liverpool Boundaries Bill extended the city's limits so as to embrace several outlying districts—thus increasing her acreage to 10,593. Today, the city and her suburbs cover an area of more than 21,000 acres. Towards the end of the seventeenth century, so records have it, Liverpool shipowners had a modest fleet aggregating 223 tons. Evidently the shipping business prospered, for by 1699 the fleet had grown to 102 vessels of 8,619 tons burden.

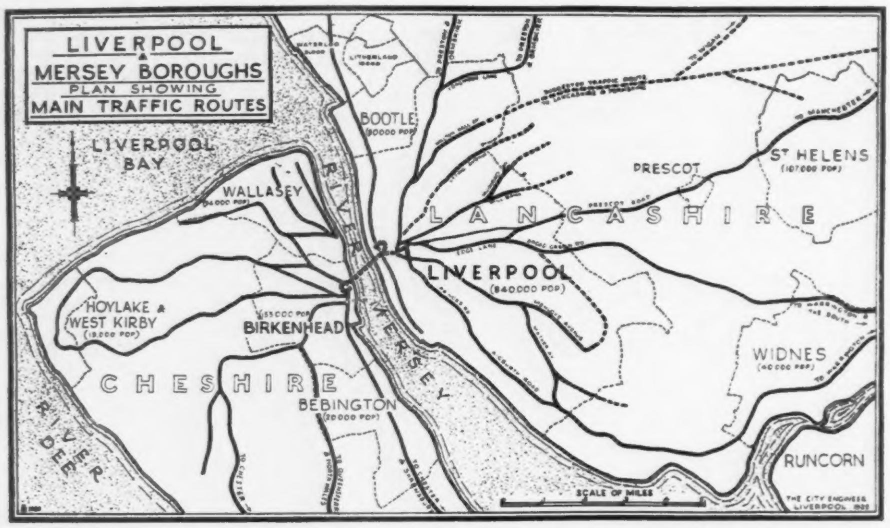
In 1709, the construction of a wet dock marked the beginning of that wonderful row of docks, some nine miles in length, which excites the admiration of the world. It might also be of interest to mention that on June 20, 1819, the *Savannah,* an American vessel, and the first steamer to cross the Atlantic, arrived at Liverpool. That port also boasts the finest landing stage in the world—the Princes Landing Stage—which is nearly half a mile long. The floating dock, as it originally stood, was opened to service on July 28, 1874, and two days afterwards was destroyed by fire—necessitating its rebuilding.

On the south bank of the River Mersey is the town of Birkenhead. With the rapid increase in the population of both Birkenhead and Liverpool, there developed the need of better means of intercourse and transportation between those neighboring cities. To relieve the situation, a tunnel was built under the Mersey in 1886, offering easy access to the Cheshire side of the river and linking up Liverpool and Birkenhead. This tunnel is 3,750 feet in length and 25 feet wide; it lies 30 feet below the bed of the river; and carries a double-track. electrified railway.

As a further aid to traffic, pedestrians and light vehicles are also conveyed across the river near the old tunnel by small steam ferry boats; and it is a matter of interest that two

Photo. Stewart Bale, Liverpool.

Drills attacking the rock on the site of old St. George's Dock at the time of the inaugural ceremonies.



The heavy traffic routes, that converge upon the points where the tunnel portals will be, indicate how necessary it is to provide a subaqueous vehicular link.

of the boats now in this service were actually used during the World War at the attack on Zeebrugge, in 1918. These boats, the *Daffodil* and the *Iris,* were put in commission again after they had been reconstructed; and in recognition of the parts they played on that great day they were renamed the *Royal Daffodil* and the *Royal Iris.*

Many suggestions have at different times in the past been made in an attempt to deal more adequately with the traffic across the Mersey between Liverpool and Birkenhead. As long ago as 1860, Mr. Jesse Hartley—first engineer connected with the Mersey Dock and Harbor Board—proposed a scheme for building a bridge over the river. Several other schemes were offered in succeeding years; and the construction, in 1886, of the now existing railway tunnel then appeared to be a solution of the problem.

As time went on, however, and the communities expanded, the tunnel could not satisfactorily take care of the traffic situation and, in 1898, another bridge project was advanced. It was suggested that a high-level suspension bridge be built with a center span of 2,000 feet, a headway for ships of 150 feet at high tide, and with two piers in the river. Several other plans were outlined, including the conversion of the existing railway tunnel into a roadway.

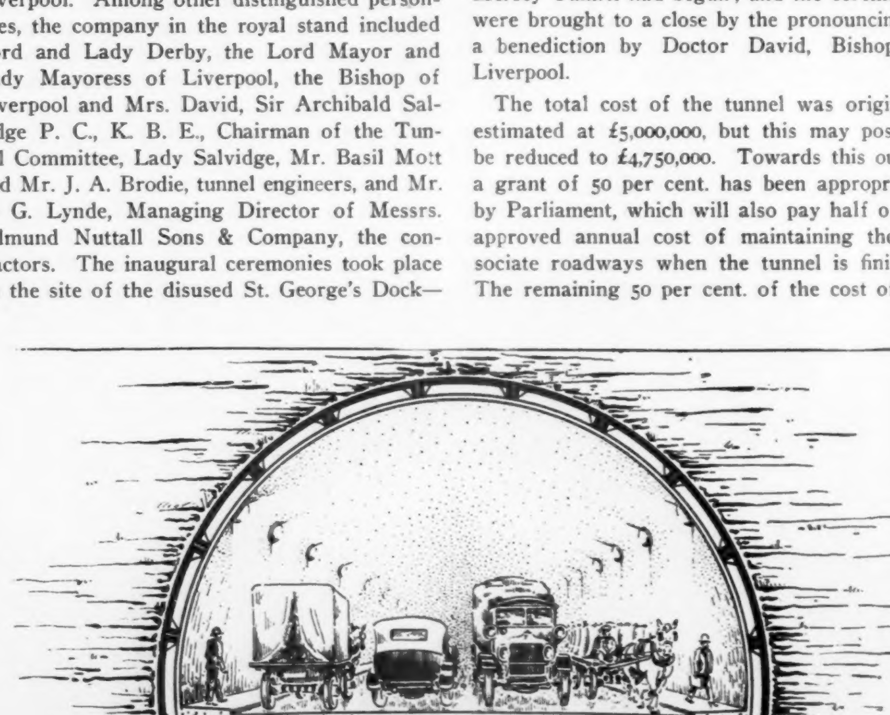
But the need for better traffic facilities had become so acute that it was decided to obtain expert advice. A report was therefore drawn up by the late Sir Maurice Fitzmaurice, Mr. Basil Mott, and Mr. J. A. Brodie—Liverpool's city engineer, that dealt with the respective merits of the bridge and the tunnel projects. This report stated that, apart from other disadvantages, a bridge would cost about twice as much as a tunnel and would not prove as satisfactory. The experts came to the conclusion that a tunnel would best serve the needs of the traffic, that was becoming more and more congested. Plans were drawn up for a new tunnel under the Mersey, and eventually a bill was presented to Parliament by Sir Archibald Salvidge. This bill was passed, and the undertaking sanctioned.

Work on this momentous scheme was taken in hand right away; and the beginning of operations was celebrated with due ceremony on December 16, 1925, in the presence of a gathering of 10,000 people. On that occasion, H. R. H. Princess Mary, accompanied by her husband, Viscount Lascelles, was the outstanding figure in the opening ceremonies held at Liverpool. Among other distinguished personages, the company in the royal stand included Lord and Lady Derby, the Lord Mayor and Lady Mayoress of Liverpool, the Bishop of Liverpool and Mrs. David, Sir Archibald Salvidge P. C., K. B. E., Chairman of the Tunnel Committee, Lady Salvidge, Mr. Basil Mott and Mr. J. A. Brodie, tunnel engineers, and Mr. G. G. Lynde, Managing Director of Messrs. Edmund Nuttall Sons & Company, the contractors. The inaugural ceremonies took place on the site of the disused St. George's Dock—the point at which the tunnel shaft is being sunk. For the occasion, the dock bed directly in front of the royal stand had been cleared of several feet of overburden to expose the underlying solid rock. On this rock floor had been painted two large white circles. In the center of each of these circles stood a pneumatic tripod drill, and round about—spaced equidistant—were six air-operated paving breakers. The white overalls of the men that operated the drills and the paving breakers added to the colorfulness of the scene.

When everything was in readiness, Sir Archibald Salvidge spoke briefly on the subject of the construction of the tunnel and touched on the advantages that would accrue to the cities of Liverpool and Birkenhead upon the completion of this connecting passageway. In handing Her Royal Highness a gold key, made in the form of a drill steel with lugged shank and 4-point cross bit, Sir Archibald said: "I will now ask your Royal Highness with this key to start the work of construction on this great national scheme."

The turning of the key on the throttle valve admitted compressed air to the drills, which sent up a noisy din that reverberated from side to side of the dock walls. Princess Mary then declared that the work of constructing the Mersey Tunnel had begun; and the ceremonies were brought to a close by the pronouncing of a benediction by Doctor David, Bishop of Liverpool.

The total cost of the tunnel was originally estimated at £5,000,000, but this may possibly be reduced to £4,750,000. Towards this outlay, a grant of 50 per cent. has been appropriated by Parliament, which will also pay half of the approved annual cost of maintaining the associate roadways when the tunnel is finished. The remaining 50 per cent. of the cost of the



Cross section of the 44-foot tunnel that will be driven through sandstone under the Mersey River. The middle division below the central driveway will be built to accommodate two lines of light vehicular traffic.

H. R. H. Princess Mary turning the gold key which released compressed air to the rock drills.

tunnel is being contributed by the different boroughs affected, as well as by tolls.

For reasons of economy, it was decided to make the tunnel as short as possible; and, accordingly, a site was chosen at a point where the river is about three-quarters of a mile wide. On the Liverpool side, two branch tunnels will be constructed with open approaches at New Quay, for heavy dock traffic, and at Whitechapel for light traffic. On the Birkenhead side of the river there will be an open approach near the Woodside Hotel.

As the tunnel will form a link between main thoroughfares of Liverpool and Birkenhead, it was deemed advisable to build the tunnel roadway at least as wide as the thoroughfares leading to the tunnel approaches, in order to avoid congestion. It has been recommended that the ruling gradient for heavy traffic should not exceed 1 in 30, and for lighter traffic 1 in 20.

The Mersey Tunnel will be two miles long and 44 feet in diameter, and will be 136 feet below the surface of the water at high tide. It is designed to carry four lines of vehicular traffic in its upper section, on a roadway 36 feet wide, and an additional 2-track roadway in its lower section. Flanking the 36-foot roadway are two footways, each 4 feet wide. The lowermost section was originally intended to have tramway tracks; but this scheme was abandoned in favor of its use for light vehicles. The headroom in the upper section is 17 feet. Ventilation and drainage will be taken care of on approved lines.

The new Mersey Tunnel will be approximately five times as large as the old one. To hasten the date of its completion, the excavating work will be done almost exclusively by labor-lightening, air-operated tools; but, even so, it is estimated that it will take anywhere from seven to eight years to finish the undertaking. It has been roughly computed that, before the tunnel is ready for service, approximately 1,000,000 tons of sandstone and earth will have been removed.

The sites of the shafts on the opposite banks of the Mersey are indicated in one of our accompanying drawings. As has already been mentioned, the shaft on the Liverpool side, on the site of old St. George's Dock has been started. This shaft will be sunk to a depth of 135 feet and will be 20 feet in diameter. The second shaft on the Birkenhead side of the river will be sunk at a point near the Wallasey Landing Stage.

Some years ago, it was suggested that inasmuch at St. George's Dock was no longer in use it might profitably be turned into an open-air swimming pool. The site was partly prepared for the purpose, and three large concrete tanks, to hold the sea water when the tide was out, were built there under the supervision of Mr. J. A. Brodie, the city engineer. However, when the new tunnel was proposed, the pool idea was abandoned in favor of this far more important public improvement; and, after the tunnel is completed, the dock will in all likelihood be filled in—thus adding valuable ground space to a congested area of the City of Liverpool.

The first contract to be let is for the sinking of the shafts on the Liverpool and the Birkenhead sides of the river and for two preliminary pilot-tunnel borings, each of 15x12 feet. These borings, it is assumed, will eventually form a part of the main tunnel. This work was awarded to Messrs. Edmund Nuttall Sons & Company, contractors, of Manchester. England, who have had a great deal of experience in their particular field and who are at the present time finishing up a big contract for the City of Manchester in connection with the laying of four miles of sewers beneath that city.

The tunnel structure will consist of a cast-iron tube, formed of separate built-up rings, and will be finished off with an internal concrete lining. Grout under air pressure will be forced into and fill all spaces between the cast-iron segments of the tube and the rock through which the tunnel is to be bored. As the tunnel will be below water level, it will be necessary to seal rock fissures in advance of the actual driving of the tunnel. Accordingly, this will be accomplished by pumping fluid cement, under pressure, into a series of horizontal holes drilled 150 feet forward from the bottom of each shaft. This work, it is understood, is to be done by the Francois Cementation Company, Ltd., of Doncaster, England.

Vehicular traffic approaching the ferry landings on the Liverpool side of the Mersey River.

SPLIT TIES QUICKLY MADE FIT FOR SERVICE

By ANDREW GIBSON*

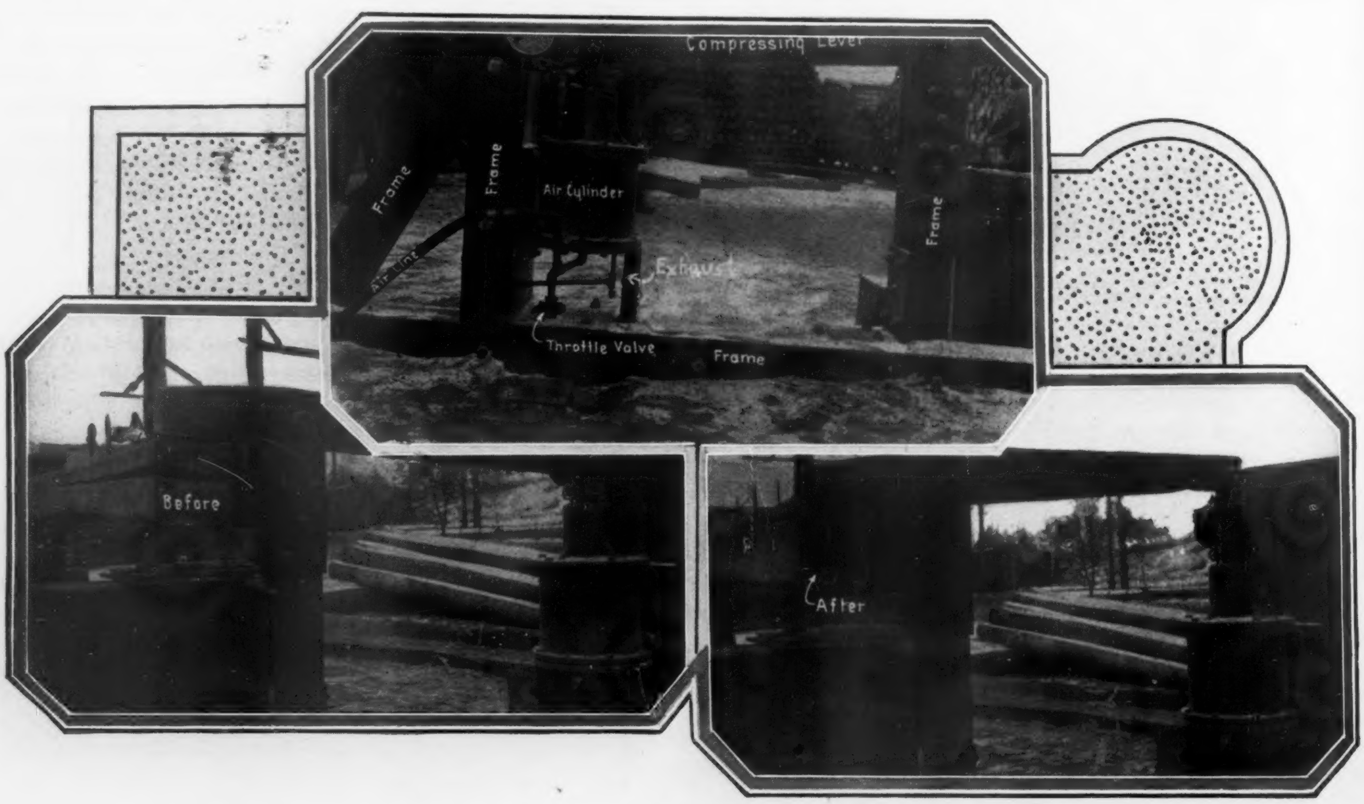
OF the large number of railroad ties that are received for treatment at the Northern Pacific Railway Company's Timber Preservation & Tie Treating Plant, at Brainerd, Minn., approximately 80 per cent. are of birch. Timber of this kind, and especially the hewn ties, have a tendency to split when seasoning, thus rendering them unfit for use. It was therefore necessary, in order to make sleepers serviceable that were satisfactory except for this splitting, to devise some means whereby these ties could be pulled together to facilitate the application of "S" irons.

For several years past, this work has been done at the Brainerd plant with a lever and a chain; but it was recognized that this method was too slow and called for too many men to dispose of the daily accumulation of split ties. But how else to do the work—how to simplify it so as to be able to reduce the number of men required to reclaim the sleepers? That was the question. As we looked at it: "It was the old story of necessity being the mother of invention, and we give 'mother' credit for the idea."

The idea took the form of an air-operated split-tie reclaimer; and just how that machine does its work is graphically shown by the accompanying photographs. The machine was built in its entirety of scrap material; and it is to the credit of our engineer and a handy man about the plant that the parts of which it is made were worked up and assembled in two days. The frame of the reclaimer was constructed of pieces of old car sills; the lever is an old piece of iron that once did service as the side rod of a small locomotive; the cylinder was formerly a brake cylinder that had been discarded because it was no longer suitable for train-line use; and even the plates and the bolts were picked up from the scrap pile.

As already mentioned, the motive power of the tie reclaimer is compressed air, which is fed to the machine through a half-inch hose—an existing air line, leading to a boring and adzing machine close by, being tapped for the purpose. It was, of course, desirable to place the reclaimer at the point of use so as to prevent any needless handling of the ties to be treated. Depending on the pull required to bring the separated ends together, air at a pressure of from 20 to 40 pounds per square inch is applied.

Under ordinary circumstances, only one man is needed to take care of the machine and to adjust the "S" irons. But when the pile reaches unusual proportions, as is sometimes the case, then two men are put on the job. With the aid of the air-driven machine, these two men can reclaim approximately 30 ties in an hour. It is worth stating here that it took three men with lever and chain to do the same amount of work that is now turned out by one man and the tie reclaimer. On an average, anywhere from 15 to 20 badly split ties have to be handled at the Brainerd plant each day; and with the equipment now available it is a comparatively easy thing for one man to do this part of the daily routine in an hour or an hour and a half—thus releasing him for other jobs.



Air-operated compressing lever used in reclaiming split railway ties. Bottom photographs show a tie before and after treatment.

Superintendent, Timber Preservation & Tie Treating Plants, Northern Pacific Railway Co.

NEW THERMOMETER RECORDS HIGH TEMPERATURES

PERSISTENT investigation and a high degree of ingenuity have resulted in the development, at the Thomson Research Laboratory of the General Electric Company, Lynn, Mass., in a thermometer that is similar in general appearance to the familiar mercury thermometer but capable of indicating temperatures above 1,800°F.

Clear, fused quartz is used for the bulb and the stem of the instrument; and gallium, one of the rarer metals, takes the place of the mercury. Liquid gallium resembles mercury in appearance but is much lighter in weight; it melts at about 86°F., but often may be cooled to more than 8 degrees below zero before solidifying; and it boils anywhere between 2700 and 3600°F., thus offering a wide recording range.

The first essential in the development of the thermometer was to place the production of the necessary quartz on a commercial scale. This phase of the problem required long and careful experimenting. Next, gallium had to come under the searching eye of the investigator in order to determine its adaptability as well as its limitations. All this has now been accomplished; and, while the instrument is not for general use, it may supersede some of the intricate devices heretofore employed for the reading of high temperatures in the laboratory.

Portable Compressors Aid Development of Mineral Properties in Canada

By F. A. McLEAN

ONE of the prime problems of a prospective mine owner is the choice of a proper compressor plant; and the size and the type of such a plant—likewise the method of drive —call for careful consideration. The choice is largely determined by the funds available, transportation facilities, and speed with which development work can be done. The selection of the most suitable drive depends on local conditions having to do with the costs of various fuels. This is an important factor.

Fuels from domestic resources vary in nature and quantity in different parts of Canada; and there are many places where conditions emphasize the desirability of plants using imported fuels, such as oil or gasoline. While stationary plants driven by internal-combustion engines frequently show marked operating economies, still plants of this sort often involve heavy initial investments and commonly require foundations and housings of a substantial character. These outlays do not pay for themselves when the prospect proves valueless, or when the plant must be abandoned or moved elsewhere at considerable expense.

Gasoline-driven portable compressors have been found valuable in opening up prospects in the circumstances referred to. They are self-contained, relatively easy to handle, and can be taken to remote claims over bad roads, rough country, or across lakes and streams that would be apt to hamper or halt the transportation of other types of plants. Furthermore, portable compressors can be put in service quickly when they have reached location. Again, portable compressors can be shifted from point to point on a property, and this can be done expeditiously and at a moderate outlay. Not only does the cost of gasoline compare favorably with the cost of other obtainable fuels, but gasoline can be more readily transported. Operating data obtained in the field confirm the advantages of the portable compressor as an aid in developing mining properties.

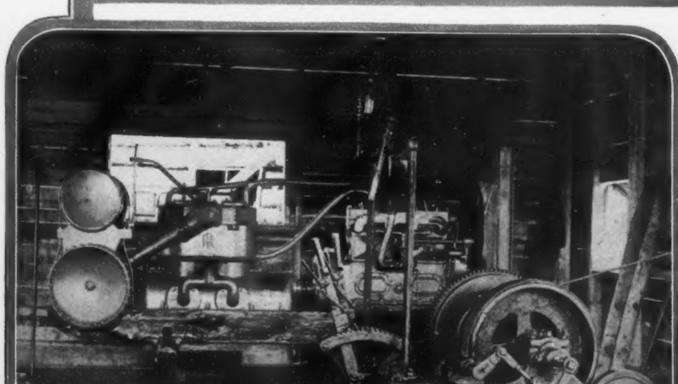
The Tonopah Mining Company, of Nevada, has recently entered the northern Ontario field, and is at present developing two silver properties in the Gowganda area. This section, situated 26 miles from railhead at Elk Lake, was first staked in 1909. Geological conditions, however, differ considerably from the wonderful "grass root" deposits of Cobalt; and it was soon found that the ore bodies lay at greater depth.

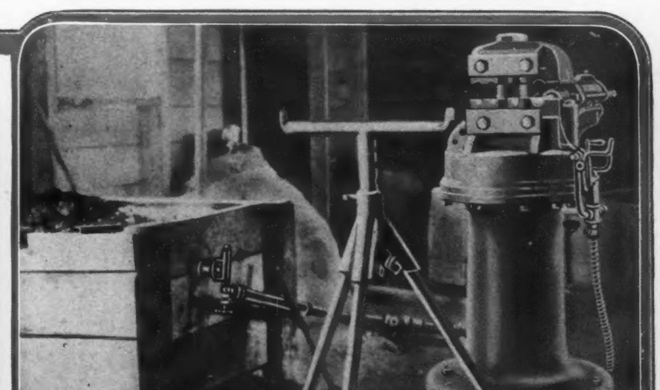
The Porcupine gold area was discovered a few months after the Gowganda district was staked, and in the general rush northward that followed but little attention was given to those promising silver deposits. Several companies held on, but they were hampered by poor transportation facilities and high fuel costs. Among those was M. J. O'Brien, Ltd. —one of Canada's greatest mining organizations, and the efforts of that concern were rewarded by the extraction of several million ounces of silver from their Miller-Lake O'Brien Mine. Later on, the directors of the famous McIntyre Mine entered the field and developed the Castle-Trethewey and the Capital Silver mines, both of which are now doing well.

There are many promising claims in this district; and, after careful investigation, the Tonopah Canadian Mines Company, Ltd., under the management of Mr. Ernest Craig, was formed to develop two properties known, respectively, as the Walsh and the Morrison claims. The first-named was equipped with a small steam plant; and a shaft had been sunk to a depth of about 400 feet before operations were abandoned. On taking over the property, the Tonopah Canadian Mines Company installed a 7-drill, Class PRS-3, compound, steam-driven compressor so arranged that it could be readily changed to motor drive should electricity be available in Gowganda, as now seems likely. With this equipment, an extensive program of development was started; and the results obtained so far amply justify the theories of Mr. Craig.

On the Morrison claims, a 60-foot shaft and a number of test pits had been sunk by the original owners, but with the exception of the two old vertical boilers no equipment remained on the property. After considering local conditions, it was decided to install a 9x8-inch portable compressor. This machine arrived at Elk Lake Station on July 25, 1925, and reached the property at 9 p. m. on July 26, after traveling several miles over dirt roads. Early on the 27th it was placed on a timber foundation, and by 10 a. m. the same day the plant was in running order. The first round was started the following morning, and was drilled and shot by 11 a. m.—or exactly 12 days after the compressor left the factory.

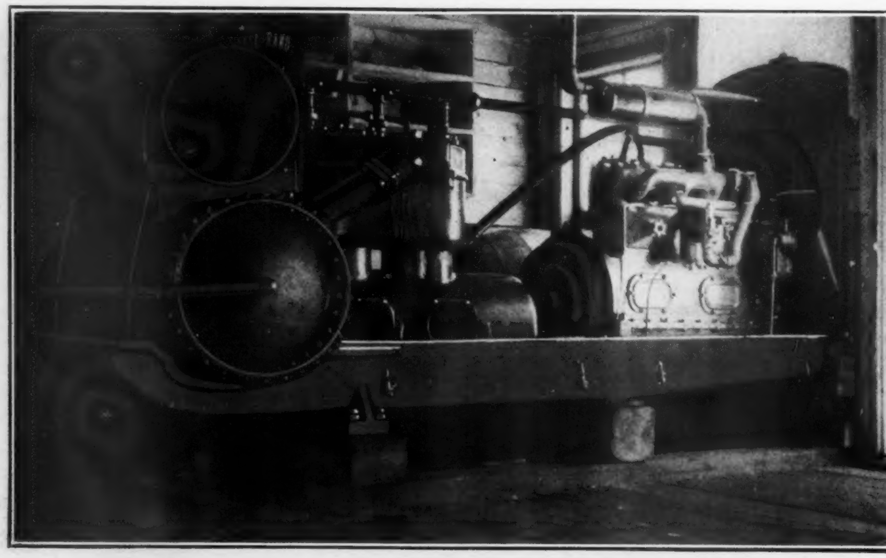
Two DDRW-13 "Jackhamers" were used to sink the shaft, which has a cross section of approximately 6x11 feet. Twenty 5½-foot holes comprised a round—the break being





Left—Type Twenty portable compressor, mounted on a timber foundation, at the Morrison property of the Tonopah Canadian Mines Company, Ltd. The arrangement is such that one man can look after both the compressor and the hoisting engine, in the foreground.
Right—The blacksmith shop on the MacMaster property at Rosegrove, Ont., is equipped with a No. 33 "Leyner" sharpener which has proved valuable in lightening labor and in speeding up the sharpening of drill steels.

about 5 feet per round. With the available equipment, the shaft was sunk to a depth of more than 100 feet in three weeks; and now a well-planned campaign of underground work is in progress. An idea of the rate of advance can be obtained from the records for the month of October, 1925, which show that 392 feet of drifting was accomplished with one R-72 drifter operating during two shifts per day. A few months earlier, an advance of 410 feet was made in a single month.



A dismounted portable compressor, housed and providing air for developmental work at a Canadian mine.

The compressor is housed in a simple wooden shack, which also contains a 6x8-inch hoist and two boilers. One of the boilers is used as an auxiliary air receiver while the other operates the hoist. In many plants of this kind it is customary to run the hoist by air, but in this case it was deemed advisable to utilize the compressor only for operating the drills and for clearing the air at the headings after a blast. One man can look after both the compressor and the hoist.

Another Gowganda property where good results have been obtained with a portable, gasoline-driven plant is the Porcupine Keora Mine, on Calcite Lake, operated by Mr. Thomas Riley of Cobalt. The compressor was taken to the property early in the Spring of 1925, when the road from Elk Lake to Gowganda was deep with mud. The 22 miles from railhead at Elk Lake to Gowganda was made by a Linn logging tractor, equipped with a Waukesha motor, pulling a trailer which carried the compressor. The total load was 14½ tons. From the main road to the mine, six horses and a block and tackle were needed to drag the compressor over a 1½-mile road having a rise of 450 feet. The trip was made without any mishap, in approximately 11 hours, despite the fact that the road was little more than a trail that was well-nigh impassable in places.

The plant at the Porcupine Keora Mine comprised a 9x8-inch Type Twenty portable, a 6x8-inch hoist, cars, buckets, etc., and was put in service during the latter part of April. The shaft was deepened, and a large amount of drifting and crosscutting done. Several thousand tons of good milling ore were placed on the dump; and by the middle of July there was started a 30-ton stamp mill, arranged for table concentration.

Another small mining project on which a portable mining plant has been employed to advantage is the MacMaster property, a few miles south of Boston Creek, Ont. On this property, a prospect pit was sunk to a depth of 25 feet by hand labor at a cost of $25 per foot. The pit was then enlarged to 7x11 feet and timbered at an outlay of $18.50 per foot, making a total cost of $43.50 per foot for the first 25 feet. An additional 35 feet of shaft was also sunk by hand, and this, including timbering, etc., cost $48.78 per foot. Then a 7x6-inch portable compressor, a DCRW-23 "Jackhamer," and a No. 33 "Leyner" sharpener were taken into the property, and with this equipment the total expenditure averaged $35 per foot of the shaft.

COMPARATIVE COSTS OF SHAFT SINKING ON MACMASTER PROPERTY

HAND METHODS	
Cost of sinking 25 ft. of 7x11-ft. shaft, including labor, timbering, explosives, etc., at $43.50 per ft.	$1,087.50
Cost of sinking shaft from 25- to 60-ft. level, including explosives, labor, timber, etc.	1,707.30
Total cost of 60 ft. of shaft sunk by hand	$2,794.80
MACHINE METHODS	
Cost of sinking 60 ft. of 7x11-ft. shaft, including timbering, labor, oil, gas, explosives, etc., at $35 per ft.	2,100.00
Difference in favor of machine methods	$694.80

Commenting on the foregoing figures, Mr. Harry MacMaster, mining engineer in charge of the property, said: "We are located right on the railway but chose a portable, gasoline-driven plant on account of its low operating cost and because it could be placed at any point on the property or elsewhere at very little expense. Wood, laid down, costs $4 per full cord; and the best wood we can obtain is

Left—This quickly built shed is all the housing required for sheltering the portable compressor which furnishes operating air on the MacMaster property at Rosegrove, Ont.
Right—It is over country like this that portable compressors have been moved to their points of service in opening up out-of-the-way Canadian mining properties.

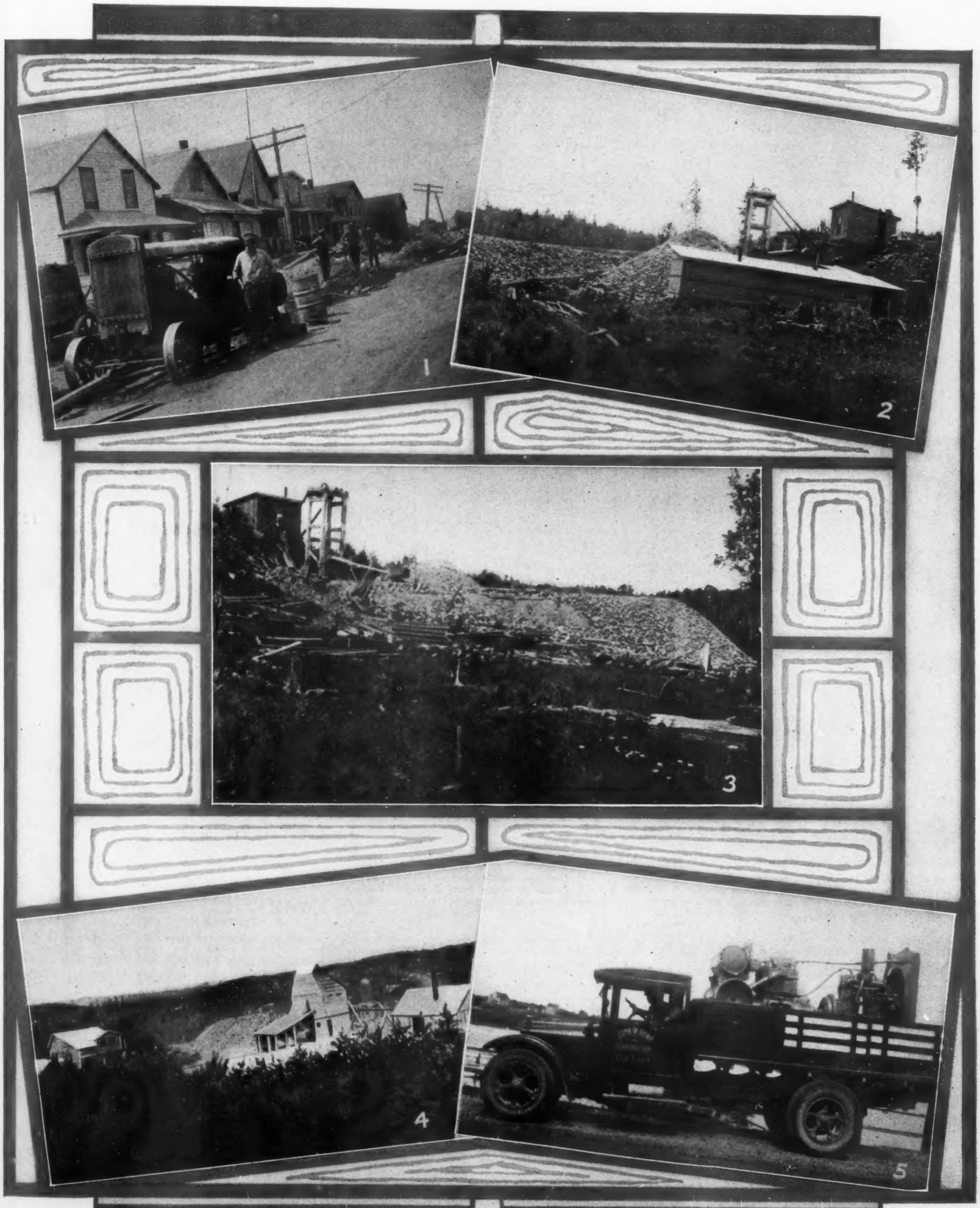


Fig. 1—Here the portable is furnishing air used to operate tools in digging a sewer trench in a Canadian mining town.
Fig. 2—Part of the MacMaster property showing blacksmith shop, head frame, and hoist house.
Fig. 3—Shaft and ore dumps on the MacMaster property, Rosegrove, Ont.
Fig. 4—Compressor and hoist house at the Porcupine Keora Mine, Gowganda, Ont.
Fig. 5—Portable compressor loaded on a truck at Elk Lake and ready to be carried to the mine on the Morrison property.

a soft birch which burns quickly and does not give much heat. I figure the cost of operating with wood would be $12 to $15 per day, and a little more than that with coal, as against $1.50 with a gasoline outfit. Our total outlay for fuel and lubricating oil, including freight, etc., has been $60.94, or about $1.50 per day. Our gasoline cost for the first 60 feet of shaft has been $48.60, or about 75 cents per foot of shaft. The rock is a hard, red porphyry; but we always cut our round of 14 holes, averaging 6½ feet in depth, in less than a shift. I find that the little drill sharpener, even for one drill, saves its cost in a short time—one man doing all our sharpening in less than two hours as against two men requiring a whole day to do the work by hand. All bits are to gage, increasing the speed of drilling and causing fewer bits to break—a source of delay and expense under ordinary conditions. I would not be without the sharpener on any account.

Getting a portable compressor over a rough bit of road, a mile and a half long, which involved a rise of 450 feet. Six sturdy draft horses were needed to complete this leg of the journey.

"We drill a round in about 4 hours, and use about 8 gallons of gasoline. Our hoist consumes about 2½ gallons per 8-hour shift; and in drilling and hoisting the muck from a 5-foot cut we only need about 11 gallons. This, I think, is a pretty good record of low-cost power. In hoisting, our 8-foot bucket averages about 10 round trips per hour, and a 5-foot cut fills from 100 to 110 buckets. Only 4 men are employed on this operation." Since this report was received, the shaft has been sunk and timbered to a total depth of 300 feet without any appreciable increase in the cost per foot. In fact, the entire operation was carried out at a cost very much lower than that at which the work is generally done in this district.

Geologists have long pointed out that the rock formation in northern Manitoba favors the existence of commercial ore bodies of gold, copper, tin, nickel, platinum, and other valuable minerals. In fact, many mining men are of the opinion that the great ore-bearing belt of pre-Cambrian rock that has given Ontario its wonderful gold mines also extends into northern Manitoba. Considerable prospecting has already been done there, and the results indicate that before long Manitoba will enter the list of productive areas.

One of the most important undertakings in this field, both as to speed of operations and size and value of ore bodies opened up, has been the development of the Kitchener claims of the Central Manitoba Mines, a subsidiary of the WAD Syndicate, on Long Lake. A remarkable record has been made at this property with portable, gasoline-driven equipment in sinking a 3-compartment, 7x14-foot shaft, and in carrying out an extensive program of lateral work.

Investigation showed that portable, gasoline-driven equipment would give the best results; and the plant shipped to the property during the latter part of February, 1925, consisted of two 9x8-inch Type Twenty, portable, gasoline-driven compressors mounted on skids; a 42-inch by 10-foot auxiliary air receiver; five DDRW-13 "Jackhamers;" four JD-10 "Jackhamer" mountings with columns, permitting four drills to be used for drifting or sinking from a bar; a No. 33 jacksteel sharpener with bit punch; three 14-cubic-foot ore buckets; three ore cars of the same capacity; and a small gasoline hoist with a rope capacity of 500 feet.

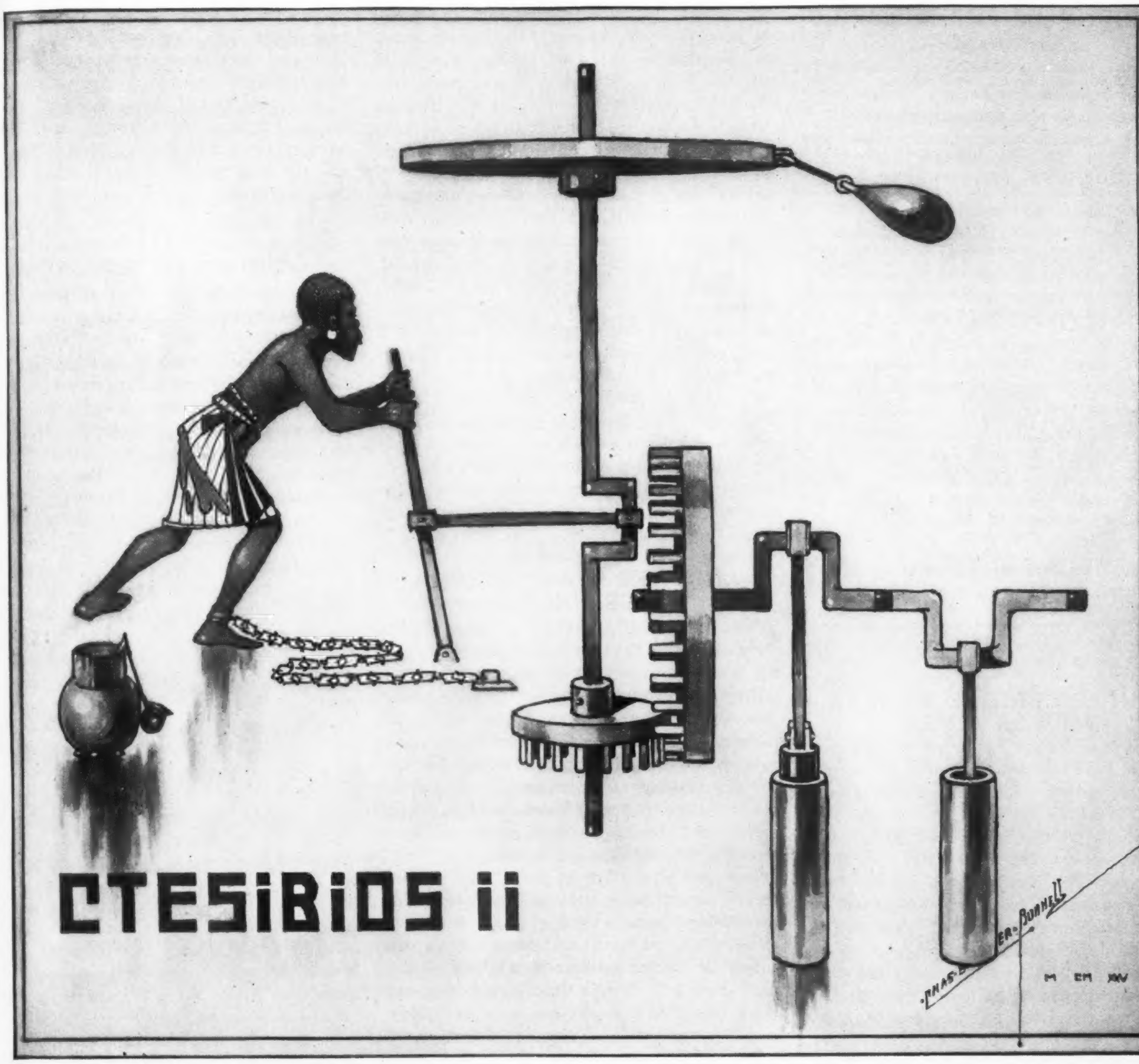
A crew of skilled hard-rock miners from northern Ontario reached the property about March 14, when the erection of the compressor house, head frame, and camp structures was started. The compressors and hoist were housed under one roof, to save attendance charges; and both compressors were connected to the auxiliary receiver, provision being made so that one or both units could be used, as desired.

No time was lost in erecting the machinery, and on April 1 the compressors and four drills were started up. Three weeks later the bottom of the shaft had reached a depth of 86 feet, an advance of about 29 feet per week. It was decided to carry the shaft down to 375 feet, at which point the third level was to be established. Stations were to be cut at the 125-, the 250-, and the 375-foot horizons as the shaft went down; and it was calculated that the 375-foot level would be reached by August 31. On the morning of August 28, however, the shaft had reached a depth of 383 feet—an average advance of well over 3 feet per day. This was a remarkable performance considering the size of the shaft and the nature of the rock.

The rounds consisted of 20 holes, averaging 7 feet in depth; and the drilling of each round necessitated the sharpening of 150 bits, which were taken care of by the sharpener without trouble. With both compressors delivering air to the receiver, and four of the drills running simultaneously, the pressure averaged 85 pounds per square inch. The total cost of gasoline for each foot of shaft sunk averaged $8. After the shaft had reached a depth of 383 feet it was decided to do about 2,000 feet of lateral development work. Two R-72 "Leyner" drifters were used; and each round consisted of 14 to 16 holes 5 feet deep. With but one drifter at work, the crosscuts were advanced at the rate of 11 feet per day. The cost of fuel averaged $4 per foot of 5x7-foot drift.

To reach the Kitchener property in the summertime entails a long canoe trip. But by reason of the limited carrying capacity of canoes, and the intervening portages, etc., machinery and supplies are usually transported to such isolated claims over snow roads during the winter months. Later, if a prospect warrants the expense, a road may be built or a railway line constructed. To get to the Kitchener claims, the equipment and supplies have to be hauled over snow roads for 45 miles. This long haul adds considerably to the expense of gasoline laid down at the property, so that the operating cost is about the same as that of a well-designed steam plant with wood-fired boilers. However, a steam plant would have meant the transportation of boilers, pumps, and other auxiliaries; the fuel would have been bulkier and harder to handle; more time would have been required to get the apparatus into service; and the attendance charges would have been higher. The gasoline-driven outfit has therefore proved much more convenient and desirable under the prevailing conditions.

By the end of the present year, the Southern Pacific Railroad Company will have completed a 100-mile stretch of road linking Tepic and Guadalajara, Mexico—thus establishing direct rail communication between any point in the western part of the United States and Mexico City, or other places farther south in Mexico. The undertaking, which will involve an outlay of $50,000,000 has called for the building of 7 big trestles, the tallest of which will have a height of 860 feet, and 27 tunnels.



EARLY EGYPTIANS MASTERED AND APPLIED DIVERS MECHANICAL PRINCIPLES

Ctesibios II, who followed in the footsteps of Ctesibios, was also a citizen of the ancient Egyptian city of Alexandria and a man of considerable genius in the realm of the mechanical arts.

In those far-off days, two centuries before the Christian era, man power was a relatively cheap commodity in the market, and the value of a slave, so we are told, fell then as low as the equivalent of eleven cents in modern money. The heaviest charge for labor at that time covered outlays for food and clothes—clothes costing much less than food.

The artist has pictured for us how Ctesibios II used man power as a prime mover in operating a 2-cylinder, hand-driven pump. It is evident that Ctesibios II knew how to utilize the lever to multiply power; how to interpose the connecting rod to transmit power; how to employ a balance or flywheel to sustain and smooth the action of reciprocal parts; and how to use a counterweight, attached eccentrically to the balance wheel, to help carry the crank of a driving shaft past the dead center.

We have no knowledge of the extent to which the mechanical combination here illustrated was used for practical ends in the days of Ctesibios II, nor do we know for what purposes the apparatus was employed at that period in the evolution of civilized man. However, it is manifest that the ancient mechanician blazed the way for many things that are today widely utilized in the realm of applied mechanics and modern engineering generally.

Mr. Bunnell has added this human-interest note to his excellent drawing: "The chain in this illustration marks the prisoner's social status, while the water bottle and the dipper indicate that his job was a virtually 'continuous performance.'"

While investigating a coal prospect six miles south of Lewiston, Idaho, the tunneling crew was astounded to discover a high-grade galena ore embedded in narrow strips in some material which had the appearance of a decayed log. On hearing of this unusual condition, says *Mining Truth*, skeptical mineralogists journeyed to Lewiston to convince themselves that galena could actually exist in such an unusual formation.

A private printer-telegraph service has been established by the American Telephone & Telegraph Company between the general sales offices of the Long Bell Lumber Company, at Kansas City, Mo., and the lumber company's producing plants at Longview, Wash., and Weed, Calif. The line has an aggregate length of 2,800 miles; and typewritten messages are transmitted and received as such well-nigh instantaneously, and at the rate of 35 words a minute.

The rapidly increasing number of oil-electric locomotives placed in service is turning the attention of locomotive engineers and railroad maintenance men to the study of the subject so that they may become qualified to manipulate and to maintain these new units. Quick recognition of the opportunities in this field of service has led the Polytechnic Institute of Brooklyn, N. Y., to organize a course of study in oil-electric engineering.

Compressed Air Magazine

—Founded 1896—

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EDITORIALS

MONSTER BRIDGE TO SPAN HUDSON RIVER

AFTER a decade or more of agitation, plans have now been prepared and agreed upon by the two official bodies immediately concerned calling for the construction of a great bridge across the Hudson River that will involve an ultimate outlay of about $50,000,000. This bridge will extend from Fort Lee on the New Jersey shore to Fort Washington on the New York side of this much traveled waterway.

Some idea of the magnitude of the projected structure can be gathered from the fact that the river span will be 3,500 feet long between the two supporting towers. In short, this span will be twice as long as that of the big bridge, now nearing completion, which will link Philadelphia and Camden, on opposite sides of the Delaware River.

The two towers will be built of granite and their tops will stand 650 feet above high water, while the suspended roadway will clear the stream by 235 feet—that is, this part of the Hudson River Bridge will be 100 feet higher than the corresponding part of the well-known Brooklyn Bridge. Each of the granite towers will rise from a base having a length, parallel with the stream, of 220 feet and a breadth of 75 feet. The foundations for these towers will rest upon bedrock; and the construction of the foundations will necessitate the employment of unusually large pneumatic caissons.

Work on the bridge will not be taken in hand until after public hearings, to be held in the two states immediately concerned; but there is no reason to believe that the popular voice will be anything but favorable to the scheme. If funds for building become available in 1927, it is said that the bridge can be made ready for traffic during 1933. This will be none too soon in view of the rapidly growing populations of the neighboring sections of the two States. Indeed, it is now recognized that the vehicular tunnel under the Hudson, soon to be finished, will not suffice to give all the traffic relief that is urgently required; and the bridge will serve the twofold purpose of taking care of a large share of this movement and of diverting it to a part of Greater New York somewhat remote from the present centers of congestion.

According to a report recently made public, the experts say: "From the engineering point of view, the construction of the bridge is in every respect feasible and, while of unusual magnitude, will involve no extraordinary difficulties or hazardous or untried operations. The architectural studies so far made, while tentative, indicate clearly that the bridge may be so designed as to form an object of grace and beauty as well as utility. In the selection of the location, careful consideration was also given to the scenic effect of the bridge."

ANOTHER GIANT POWER PROJECT

CALIFORNIA is setting a commendable example in the way she is putting to use for power purposes the latent energy in her falling waters. Notwithstanding the tremendous sums of money spent by her enterprising public utilities in creating numerous large hydro-electric stations, still the San Joaquin Light & Power Corporation has planned to spend $50,000,000 more in devising facilities by which to draw power from the Kings River in the central section of the state.

To accomplish this, a 3-mile tunnel will be cut through the solid granite backbone of a mountain so as to bring water from one side of that barrier to the other side, where it will be discharged into a penstock which, in its turn, will deliver the water to a power house nearly half a mile below in the valley. In this power house will be placed four of the largest of horizontal water-wheel generators. An incidental part of the construction of this great undertaking will be the cutting of a roadway out of the steep granite side of the mountain; and before the whole job is finished there will be much work for the air-driven rock drill to do.

PERSEVERANCE WINS

MANY a man has failed to reach his goal only by quitting just too soon. Trite as this saying is, still it received added and dramatic emphasis a few weeks back.

According to a news report from California, one AUSTIN BURCHAM, some time during 1898, sank a shaft 40 feet deep in the Kramer Hills in search of gold which he believed to be there, and then he halted his efforts when word reached him that gold had been struck elsewhere in the country. BURCHAM had actually drilled the holes for a last shot; had the powder at hand to load the holes; and then quit in haste without bringing his work to his intended conclusion.

For 28 years the abandoned shaft remained unexplored, and the powder lay undisturbed just where BURCHAM had left it. Then, in March of the present year, another prospector had sufficient curiosity to explore the abandoned shaft and to load the drill holes to see what BURCHAM's contemplated shot would have revealed had it been fired. The result was the exposure of a vein of gold which is reported to contain ore that will run $1,000 a ton!

AND STILL WE GROW

BY means of a system of arithmetical progression, the United States Census Bureau computes our present population to be 117,135,817. This estimate is based on the actual census taken in 1910 and again in 1920—supplementing these figures with data furnished by those states that made independent counts last year. According to the statement issued by Government statisticians, the population of the country has increased by 11,425,197 in the past five years.

While this growth of our population adds proportionately to the man power of the nation, it increases directly the number of mouths to be fed upon a dietary scale which we are pleased to term typically American. Recently, students of our economic life have declared that our foodstuffs are not being raised in quantities commensurate with the multiplication of the people within our gates, and we are warned that something must be done to relieve this potential approach of a period of reduced rations.

Despite the pessimists, news comes from Alaska that we may still continue to eat our accustomed allowance of meat even though our herds of cattle dwindle on the ranges and the farms south of the Canadian border. That is to say, we may look to the reindeer to make up any deficiency in the matter of meat. It will be recalled that reindeer were introduced into Alaska from Siberia by the United States Government after several Alaskan villages were wiped out through starvation. The original herd so transplanted numbered a few more than 1,000. Today, the reindeer herds of Alaska aggregate substantially 500,000 head. Reindeer meat is said to be both succulent and palatable; and to the end of making this excellent foodstuff better known, an educational campaign has been instituted far and wide within the country by placing reindeer meat on the menus of many of our hotels and restaurants.

FOREIGN TRADE A REFLEX OF THE WAY WE LIVE

THE future of our foreign trade was dwelt upon recently by SECRETARY HOOVER before the representatives of a number of associations having to do with our industrial life and especially with our export business. MR. HOOVER touched upon many phases of this economically vital subject, and then brought his speech to a close in the following manner:

"If we can keep in motion the social and economic forces which we have developed so greatly in the last decade; if we can multiply and improve education and skill; if we still

further stimulate scientific research; if we continue to improve our business organization and maintain private initiative, we shall hold our own in our share in the world's trade.

"By contributing to peace and economic stability; by the loan of our surplus savings abroad for productive purposes; by the spread of inventions over the world, we can contribute to the elevation of standards of living in foreign countries and the demand for all goods.

"Ours is not a nation of factories, railroads, dynamos, warehouses, trade, or ships. It is a nation of men and women and children. When we consider these themes of production and trade we need be indeed guided in our conclusions by that course which will promote their welfare and comfort. If by our efforts and our discussions we enlarge their standards of living it is an economic thing; but it is a far greater thing than this, for security and living and comfort yield the opportunity for that greater fullness of life of the spirit, which is the true purpose of human service."

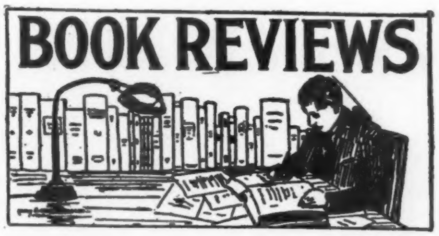
IS THE BUSY BEE A LOAFER

FOR ages the bee has been held up to the world as an exemplar of industry. From the first warm days of spring to just before the frosts of fall, the bee labors industrially to harvest honey and to put it away against the day of need. Even so, the bee has, so it would seem, been only half as busy as it might have been; and now we learn that the scientist has discovered the fact and blazed the way to make the bee work year in and year out.

According to *Agricultural and Industrial Progress in Canada,* 140,000 bees have been shipped from their habitat in Canada to antipodean New Zealand, where they have been kept busy making a living for themselves and their owner instead of hibernating in Canada and eating up the store of honey laid up by them there last summer.

While this development in bee-keeping is as yet in the experimental stage, nevertheless the bee is responding to the test in an extremely encouraging manner. Mr. JAMES BALLANTYNE, of British Columbia, who is responsible for the venture, says: "Economically and financially, it would appear that the recurrent expenses of so great a journey would outbalance the returns." But he points out that ascertained facts show that the saving in the expense of winter feeding for twenty weeks pays for the few pounds of sugar the bees need on the journey, while the expense for special traveling cages is not so great as the cost of winter cages so necessary in Canada. He is satisfied that the doubled natural increase of the bees will cover all transportation charges when this system of migration is established upon a commercial scale. Be this as it may, most of us would be inclined to sympathize with the bee, and vote that industrious creature a period of relaxation.

A curious situation and a somewhat perplexing problem has arisen in connection with electric installations on the Swiss railways. Large birds of prey, which are especially numerous in the thickly wooded Canton of Valais, have fixed upon the elevated insulators as suitable resting places from which to watch for their prey. When they take off from these lofty positions, their widespread wings, contacting with the high-tension wires, are apt to form short circuits—thus causing trouble in the power houses. To prevent interference by these birds, it has been found necessary to surround the insulators with excluding wire guards.



CREATIVE CHEMISTRY, by Edward E. Slosson, M. S., Ph.D. A book of 311 pages with copious illustrations, published by The Century Company, New York City, and made available at a reduced price by The Chemical Foundation Incorporated, New York City.

IT HAS not yet fully dawned upon the public how much it owes to the chemist for thousands of the things that contribute in one way or another to the well-being, the comfort, and the security of the populace. Doctor Slosson has the gift of presenting the essentials of a technical subject in language that is so lucid that the run of his readers are charmed while being educated. It is not possible to mention in detail any of the topics covered by the volume, but the comprehensive nature of the book can be gathered from the statement that the pages touch upon such matters, in which creative chemistry has played a part, as the fixation of atmospheric nitrogen; feeding the soil; coal-tar colors; synthetic perfumes and flavors; the race for rubber; rival sugars; what comes from corn; solidified sunshine; products of the electric furnace, etc., etc. Most of us can learn much from the book.

POPULATION PROBLEMS IN THE UNITED STATES AND CANADA, edited by Louis I. Dublin, President, American Statistical Association, 1924. A book of 318 pages, published by Houghton Mifflin Company, New York City. Price, $4.00.

WE have in this work an authoritative and a contemporary discussion of certain critical phases of the population problem as viewed by 25 separate authors, each of whom is recognized as eminent in the special department of the subject treated by him. As the editor expresses it: "With all its open spaces, America has a particularly interesting and perplexing population problem which insistently bids for attention. The unparalleled growth in numbers, the intermixture of races, the rapid depletion of natural resources, the declining fertility in the cities, the urban migration, and the more recent curtailment of immigration, all make America a remarkable laboratory for the study of population. Here are combined unrivaled opportunities for investigation and unlimited possibilities for turning theories into practical channels."

None of us can afford to be unmindful of the social and the racial influences at work in this country if we are to be seriously concerned with the practical perpetuation of the traditions of the nation.

LEAD, THE PRECIOUS METAL, by Orlando C. Harn. A work of 323 pages, with many illustrations, published by The Century Company, New York City. Price, $3.00.

TO most of us lead is a common material that scarcely warrants the appellation "precious," but the author justifies the term by showing us in how many ways—some of them indispensable—lead serves us at every turn of life and in every department of complex modern industry. The presentation of the subject may more properly be termed a story and not a technical treatise. Mr. Harn has aimed to appeal to the average person by arraying a great many interesting facts about lead and its compounds. He takes the reader from the source of lead—the mine—through the refining processes and into those fields in which metallic lead and lead compounds of various kinds have important parts to play. He has succeeded admirably in his efforts to entertain and to inform. The book, while in no wise deep, is both authoritative and comprehensive.

THE United States Bureau of Mines has given out the following list of new publications:

BULLETIN 256. *Garnet: Its mining, milling, and utilization,* by W. M. Myers and C. O. Anderson. 1925. 51 pp., 3 pls., 3 figs. 15 cents.

BULLETIN 257. *Review of safety and health conditions in the mines at Butte,* by G. S. Rice and R. R. Sayers. 1925. 29 pp., 8 figs. 10 cents.

TECHNICAL PAPER 320. *The Bureau of Mines Orsat apparatus for gas analysis,* by A. C. Fieldner, G. W. Jones, and W. F. Holbrook. 1925. 18 pp., 1 pl., 4 figs. 5 cents.

TECHNICAL PAPER 367. *Value of bituminous coal and coke for generating steam in a low-pressure cast-iron boiler,* by C. E. Augustine, James Neil, and William M. Myler, Jr. 1925. 45 pp., 1 pl., 19 figs. 10 cents.

TECHNICAL PAPER 388. *Coke-oven accidents in the United States during the calendar year* 1924, by William W. Adams. 1925. 38 pp. 10 cents.

MINERS' CIRCULAR 29. *Misuse of flame safety lamps and dangers of mixed lights,* by L. C. Ilsley. 1925. 12 pp., 4 figs. 5 cents.

Copies of the publications may be bought from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Announcement has been made of the appointment of Harlan A. Pratt as manager of the Oil and Gas Engine Department of the Ingersoll-Rand Company. For many years, Mr. Pratt was connected with the Sales Department of the Westinghouse Electric & Manufacturing Company, later becoming sales manager of the Atlantic Elevator Company, exclusive agents in the East for Westinghouse gearless traction elevators. For the past three years he has been sales manager of the Elevator Supplies Company, of Hoboken, N. J.

Mr. Pratt was graduated from Stevens Institute of Technology, and was at one time director of the American Institute of Electrical Engineers.

ANTIOXIDANT ADDS TO THE DURABILITY OF RUBBER

IT HAS been known for some time that deterioration of vulcanized rubber through oxidation can be delayed by the use of substances which, themselves, are easily oxidized and which act as anticatalysts of oxidation. Recently, two large rubber companies simultaneously patented almost identical antioxidants.

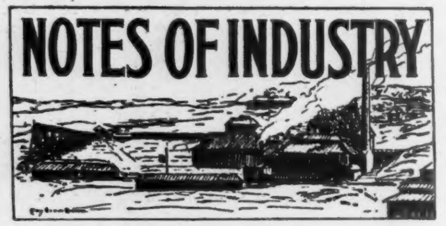
Accelerated aging tests of rubber compounds, containing one of these antioxidants, have substantiated the claim that the durability of rubber, with respect to the effects of light and heat, can be increased thereby about 600 per cent.

PNEUMATIC UNLOADING OF COPRA

COPRA, the dried meat of the cocoanut, is now so much in demand by the housewife, the baker, and the candy maker, that great shiploads of the toothsome foodstuff are sent each year from the far-away South Sea Islands, in the Pacific, to San Francisco, Cal.

In the past, the work of unloading this commodity has been slow and toilsome. But now, as is the case with other bulk cargoes, such as grain, special pneumatic equipment is employed to transfer the copra from the hold of a vessel to waiting cars for trans-shipment to distant points in the United States.

By the aid of the pneumatic unloader, the work that formerly called for the services of a crew of 25 stevedores can now be done by but three men—two aboard the ship to guide the intake of the suction line of the apparatus so that it will take up its maximum load, and one on the dock to operate the machinery and to direct the loading of the cars. The cars are packed solidly from floor to roof by reason of the force with which the material is thrown from the discharge end of the pipe. In this way it is possible to transfer from 30 to 40 tons of copra in an hour. By means of a suitably disposed vacuum tank, all dust and foreign matter are separated from the copra as it leaves the vessel—thus assuring a relatively clean product.



In Norway, considerable activity is observed in the development of substitute fuels, most of them having as their base a sulphite spirit, of which the country, with its extensive forests and wood-pulp and paper industries, has an abundant supply. So far the work is only in an experimental stage; but in some instances the progress reported indicates that substitute fuels must soon be reckoned with. Norway, alone, is said to be in a position to supply about 25 per cent. of her present motor-fuel needs from domestic sulphite-spirit sources.

The per capita consumption of paper in the United States amounts to 45 pounds a year.

One of the newest uses of copper is in the manufacture of electric refrigerating units. It is estimated that 30,000,000 pounds of copper will be demanded for this purpose in 1926.

"Cement fondu," hitherto produced only in France, is now also to be manufactured in England—the Lafarge Aluminous Cement Company, Ltd., recently having celebrated the completion of its plant, which has a maximum capacity of 150,000 tons of cement per annum.

This material contains a high percentage of alumina, and has the valuable characteristic of hardening very rapidly. It is produced by smelting a mixture of chalk or limestone and bauxite; and differs from Portland cement not only in its composition but also in its manufacture—its raw materials actually being fused or melted while the constituents of Portland cement are not heated to nearly as high a temperature.

The firm of Wiebe & Konsorten, Hanover, Germany, recently announced that it can produce a synthetic rubber that will be able to compete with the natural product. It is said that by isolating isoprene from potatoes and their by-products, and by adding various chemicals to this substance, a material is obtained that is not unlike crude rubber. At the present time, the plant is manufacturing about 2,000 pounds daily. The scientific world will probably await with interest the outcome of the experiments being made by this German concern.

Not long ago, a heavy storm uprooted a tree at Clarksfork, Idaho, uncovering a wide vein of silver-lead ore that had been sought unsuccessfully for years.

Sweden has a total land area of approximately 158,500 square miles, of which about 52 per cent. is forested.

Last year, Great Britain added 120 miles to her existing concrete highway system, bringing the total mileage up to 250.

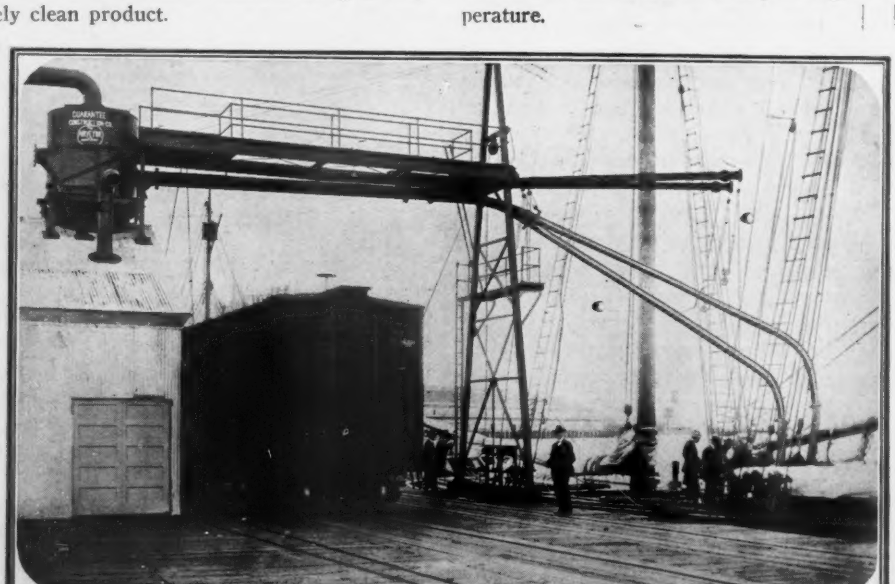
What will be the world's largest and most powerful mine hoist is now in course of construction at the Manchester works of the Metropolitan-Vickers Electrical Company, Ltd. This hoist is being built for the City Deep gold mines of South Africa, and is designed to lift nearly 10 tons of ore from a depth of 4,500 feet at a rate of about 40 miles an hour—a load every two minutes.

Just what the construction of this hoist involves can be gathered from the following figures: Electric power for the hoist is to be generated by a 300-ton dynamo; the two winding drums, each of which will have a diameter of 35 feet, and the shaft on which they are to be mounted will weigh over 400 tons; and the winding rope will have a weight of 18 tons.

According to figures published by the Common Brick Manufacturers Association, there were consumed in the United States last year about 8,000,000,000 bricks, or enough to build the foundations, chimneys, and walls for 267,000 average homes.

After spending more than $4,000,000 in exploratory work, the Imperial Oil Company, Ltd., according to its president, Mr. C. O. Stillman, "has at last obtained a supply of crude oil in Canada." One well in the Province of Alberta is now yielding more than 500 barrels daily, and is showing no signs of diminution. This is the famous Royalite No. 4 Well, which was "brought in" in October of 1924. In addition to the oil, the well produces daily about 18,000,000 cubic feet of natural gas, 14,000,000 cubic feet of which is distributed for domestic use through the mains of the Calgary Gas Company.

The American public spends $365,000,000 a year for candy, or $1,000,000 a day—the confectionary business ranking fifth among the nation's industries.



A vessel from the South Seas, loaded with copra, having her cargo removed by the two suspended pneumatic pipe lines.

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